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Soil Survey of The Dixon Area, California

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Bureau of Chemistry and Soils
In cooperation with the
University of California Agricultural Experiment Station

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SOIL SURVEY OF THE DIXON AREA, CALIFORNIA

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AREA SURVEYED

The Dixon area is in the southwestern part of the Sacramento Valley (fig. 1), lying at the eastern base of the Coast Range. The northern part of Solano County and a contiguous southerly projection of Yolo County are included in the area which is roughly rectangular in shape and has a total extent of 435 square miles, or 278,400 acres. Its western boundary is the Napa-Solano County line along the the crest of Vaca Mountains; its eastern boundary is the curving course of Sacramento River; the northern boundary follows the channel of Putah Creek to the river; and the southern boundary is the north line of T. 5 N. (Mount Diablo base), which is the northern boundary of the Suisun area (*1*).[1]

FIGURE 1.—Sketch map showing location of the Dixon area, Calif.

The surveyed area joins in part with, and includes a small part of the much earlier soil survey of the Woodland area (*4*), and includes a part of the area covered by the reconnaissance soil survey of the Sacramento Valley (*3*).

Three distinct physiographic divisions characterize the Dixon area: (1) The mountain-and-valley unit, (2) the piedmont plain, and (3) the river-basin and island division. Each of these major divisions includes two or more subdivisions, separated on the basis of local relief, agricultural practices, or soils.

The mountain-and-valley unit comprises the western one-fourth of the area. It includes the eastern slope of Vaca Mountains, the structural trough of Pleasants and Vaca Valleys, and the English Hills. The eastern slope of Vaca Mountains is steep and rugged, the mountains rising abruptly to a height of more than 2,000 feet. Mount Vaca, the highest point in the area, has an elevation of 2,870 feet above sea level. A number of short streams have cut deep V-shaped valleys down this eastern slope, and roads have been constructed up some of them to reach the small and irregular bodies of arable land which have been partly cleared. With the exception of these few clearings, the slope is covered with trees and brush, oaks dominating the lower elevations and pines the upper. The wooded

[1] Italic numbers in parentheses refer to Literature Cited, p. 46.

and brushy slopes are used to some extent for grazing and the cleared areas for the production of apples and grapes.

The narrow trough of Pleasants and Vaca Valleys extends along the eastern base of the mountain slope from Putah Creek to the southern boundary of the area. Surfaced largely with alluvium from the adjacent heights, the gently sloping valley floors are dotted with small remnant hills, and one group of these, situated midway of the trough, with an elevation of about 500 feet, serves as a drainage divide. Pleasants Valley lies north of this divide, its streams emptying into Putah Creek, and Vaca Valley lies to the south, its drainage collecting in two small streams, Alamo Creek and Ulatis Creek, which at Vacaville pass through the barrier of hills to flow eastward. Both valleys have deep fertile soils, good supplies of water, and climatic conditions favoring fruit production. Both are almost wholly planted to deciduous fruit orchards—a type of land utilization which has been sufficiently successful to lead to the extension of orchard plantings to the adjoining slopes of the mountains and hills.

The English Hills comprise a roughly ovate area of deeply dissected uplands, the broader end lying along Putah Creek and the narrower one breaking into a series of low ridges in the vicinity of Vacaville. The western boundary is a comparatively steep escarpment having a maximum elevation, at Putnam Peak, of 1,225 feet. The eastern limit is poorly defined, the lower slopes of the hills and ridges merging almost imperceptibly with the gently sloping piedmont plain at about the 100-foot contour. Crest conformity in this subdivision is suggestive of an ancient peneplain, or alluvial fan, having a gradient toward the southeast of about 500 feet to the mile. Erosion has been particularly active, especially in the central and eastern parts, where the strata are thinner and more softly consolidated. Many small streams—Dry Arroyo, Sweeney Creek, and others—have their headwaters near the western crest and follow irregular courses down erosional valleys to the eastern plain. The sharp relief and minor elevations of the English Hills are conducive to good air drainage, damaging frosts seldom occur, and much of the more accessible areas is planted to deciduous orchards and vineyards. Winter crops of garden peas are grown to some extent.

The piedmont plain of the west side of Sacramento Valley extends as a north-south belt across the Dixon area. It comprises the central half of the area, being bounded on the west by the mountain-and-valley unit and on the east, at about the 10-foot contour, by the higher limit of flood waters in the Yolo By-Pass. This broad and gently sloping plain is of alluvial origin, aggradation being still in progress over the greater part of it, and Putah Creek is the most important source of recent and present deposits. This stream not only is depositing its alluvium along the present channel, but within comparatively recent times it has built up a branching and interlacing pattern of dual ridges that extend around the northern base of the English Hills and spread fanlike over the plain, terminating at different points several miles south and east of Dixon. One of the larger, and the westernmost, of these ridges, Dixon Ridge, begins at Putah Creek just west of Wolfskill School and extends southward through Batavia, disappearing about 4 miles east of Elmira.

Between Dixon Ridge and the English Hills is an extensive body of old alluvium which has not been mantled by the younger deposits. This body has a smooth and gently sloping surface relief, dotted by a few scattered low hills and ridges of similar material and traversed by several slightly entrenched streamways. This old alluvium apparently extends eastward under the large area of more recent deposits, being reached at comparatively slight depths in a number of wells and also occurring as small knobs and slightly elevated bodies as far east as the Yolo Basin. Two small alluvial fans are being built on this area of older material, the first by the dual agency of Alamo and Ulatis Creeks east of Vacaville and the second by Sweeney Creek in the vicinity of Allendale.

A striking feature of the drainage pattern in both the old and the young alluvial deposits is that none of the streams, including Putah Creek, directly connects with Sacramento River. Local stream flows spread out over the lower and flatter parts of the plain, converging in shallow natural troughs, augmented by artificial drains, and finally empty into the near-sea-level depression of Yolo Basin.

In general the soils developed on the old alluvial deposits are not so well suited for intensive agriculture as are those on the more recent deposits. Sheep raising and grain growing are the two important activities conducted on the soils of the old alluvial deposits, but orcharding is essentially absent. Two or more small-farm subdivisions have been laid out on these soils, but only in exceptional cases have the purchasers been successful. In contrast, the higher lying and better drained areas of recent alluvial soils have been farmed profitably for years. Orchards, mainly of deciduous fruits, dominate most of these areas, but general farming and livestock raising are important activities in the neighborhood of Dixon. In the flatter areas, which are wet during a part of the year, grain growing and sheep raising are the dominant activities, although several hundred acres are utilized for producing sugar beets.

The river-basin and island division covers the eastern fourth of the area. It includes the Yolo By-Pass and an extensive body of reclaimed land lying between the eastern levee of the by-pass and Sacramento River. Before reclamation, all this broad troughlike depression paralleling the river was periodically inundated. Its lower parts, being at or near sea level, were wet throughout the year and supported a dense growth of tules, sedges, and similar vegetation. Alluvial increments were greatest along the river and the meandering waterways and resulted in an irregular pattern of "natural levees", on which grew willows, cottonwoods, and associated plants. By the construction of high levees on these natural ridges, Lisbon and Merritt Islands were early reclaimed. This reclamation was followed by the completion of Yolo By-Pass and the subsequent development of the Holland tract. Yolo By-Pass is one of the units in a comprehensive measure for controlling the run-off of the Sacramento River system, water being diverted into it during periods of heavy flow, in order to relieve the levees along the main stream and reduce the hazard to the adjacent intensively developed lands. For this reason the land along Yolo By-Pass is comparatively undeveloped agriculturally, but it is used during the summer as pasture land for sheep and other livestock and in the

autumn and winter by duck-hunting clubs. Only a small part of it, about 1,000 acres, which have been protected by a low levee, is planted to summer crops, such as beans and milo.

East of the by-pass levee is a notable agricultural district (pl. 1, A). Orchards, principally pears, are planted along the higher and better drained parts of the stream ridges, and sugar beets are grown on the fine-textured soils of the lowest land. Asparagus, alfalfa, beans, onions, and other crops are produced on intermediate areas, the alfalfa from Lisbon Island having early achieved local renown. Drainage is an important problem in this district, as the water table is only a few feet below the surface—less than 4 feet in some of the low-lying areas. Many of the former lakes and channels have been drained or filled, open drainage ditches have been constructed, and pumps are operated to lift large quantities of ground water over the levees.

The population of the Dixon area was approximately 10,500 in 1930, which represents an increase of 44 percent over the 1910 figure of 7,250.[2] Most of the inhabitants are engaged in agricultural pursuits, and the majority of them are rural residents. A large number are descendants of the earlier settlers, the first of whom reached this locality in 1842. In recent years the population has been augmented by immigrants from other parts of California and from the Central States. At present a number of orientals, mainly Filipinos, have assembled in the island country and are employed in the production of asparagus and other hand-labor crops.

Vacaville, with a population of 1,556, and Dixon, with a population of 1,000, are the only incorporated towns. Winters and Davis, located just outside the area on the north bank of Putah Creek, are important trading and shipping points for contiguous localities south of the creek. Fairfield, the county seat of Solano County, is about 5 miles south of the southwestern corner of the Dixon area, and Sacramento, the State capital and a railroad center, is a like distance north of the northeastern corner. The metropolitan district of the San Francisco Bay section, with its large population and varied economic interests, is about 40 miles southwest of the area.

Transportation facilities are good. The San Francisco-Ogden branch of the Southern Pacific Railroad crosses the area, passing through Dixon and the small junction point of Elmira. A branch line of this railroad runs westward from Elmira to Vacaville and thence northward to Winters, serving the western fruit-producing section. The Sacramento Northern Railway, an electrical unit in the Great Northern-Western Pacific system, traverses the eastern half of the area and has two local branches; the first serves the district of intensive agriculture along Sacramento River and the second extends westward to the Vacaville-Fairfield section. Good paved roads are common throughout the greater part of the area; even in the poorly drained district bordering Yolo By-Pass, the principal roads are graded and graveled. The State highway connecting San Francisco and Sacramento passes through Vacaville and Dixon, and along this arterial route large quantities of farm products are transported by autotrucks to San Francisco and other nearby markets.

[2] Estimates of population are based on summations of United States census reports for the (civil) townships included in the Dixon area.

CLIMATE

The climate of the Dixon area is characterized by hot, dry summers and cool, moist winters. At Vacaville, the only point within the area for which United States Weather Bureau records are available, the mean annual temperature over a 43-year period is 60° F.; July has a mean of 74°, with an absolute maximum of 115°; and January has a mean of 46.8°, with an absolute minimum of 19°. These temperatures are essentially the same as those at Davis and other nearby stations in the Sacramento Valley, but they are somewhat higher than those at Napa and in the neighboring valleys of the coast range (fig. 2). Some variation in length of the frost-free season exists between different points in the area. At Vacaville the average length of time between the last and first killing frosts, March 18 and November 20, respectively, is 247 days, or about 8 months, but frost has been recorded as late as May 2 and as early

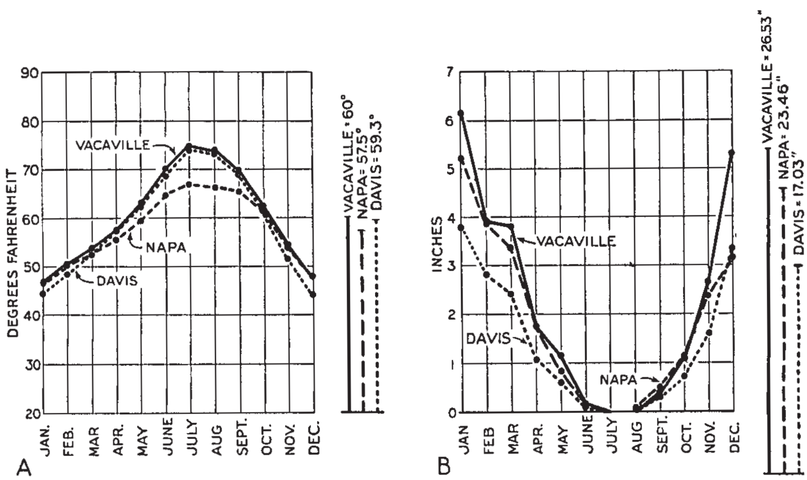

FIGURE 2.—Mean annual and mean monthly temperature and precipitation at Vacaville, Napa, and Davis: *A*, temperature; *B*, precipitation.

as September 19. Parts of the English Hills, favored with good air drainage, are sufficiently free from frost to allow the successful production of winter crops of garden peas, and some narrow and slightly elevated belts along Putah Creek are also marked by comparatively mild winter temperatures, frost damage seldom being evident in the few small plantings of citrus fruits located on these thermal ridges. In contrast, the low-lying areas of Yolo Basin and the higher valleys of Vaca Mountains are marked by lower winter temperatures and shorter frost-free seasons than those at Vacaville.

The greater part of the annual precipitation falls during the winter and early spring, with little or none during the summer and early autumn; approximately 75 percent of the annual rainfall occurring during the 4-month period December to March, inclusive, and less than 2 percent from June to September, inclusive. There is an even more marked variation in the rainfall than in the temperature between different points in the area. A southeasterly extending lobe of higher precipitation, covering the mountain-and-valley divi-

sion to the west, includes the vicinity of Vacaville, which has an annual rainfall of 26.53 inches. This amount is about 3 inches more than that recorded at Napa and nearly 10 inches greater than that at Davis.

Not only is there a range in annual rainfall of about 10 inches between the eastern and western parts of the Dixon area, but there is also a wide variation from year to year. This is demonstrated by the 51-year record at Vacaville. In 1884, the wettest year, slightly more than 50 inches fell at this station, and in 1898, the driest year, the total precipitation amounted to only 10.32 inches. During such dry years, the agricultural interests are obviously dependent on a supplementary supply of water. This is provided, in part, by surface and subsurface movement of water from the nearby mountain slopes and uplands and, in part, by pumping from the deeper zones of underground water established during periods of greater precipitation. In years of high rainfall the lower and flatter land is excessively wet, and the planting of crops is delayed and sometimes entirely prevented. It is significant that farmers operating in the southeastern part of the valley plain obtain the better yields on the slightly higher ridges and elevations in wet years, whereas in dry years the better yields are produced on the lower interridge land.

Table 1, compiled from records of the United States Weather Bureau station at Vacaville, gives the more important climatic data for the western part of the Dixon area.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Vacaville, Solano County, Calif.*

[Elevation, 175 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1898)	Total amount for the wettest year (1884)
	°*F.*	°*F.*	°*F.*	*Inches*	*Inches*	*Inches*
December	47.7	74	20	4.93	3.22	16.18
January	46.8	78	19	5.64	1.65	6.02
February	50.1	82	20	4.25	2.49	7.19
Winter	48.2	82	19	14.82	7.36	29.39
March	53.6	80	27	3.57	1.06	11.45
April	57.6	97	27	1.78	.51	7.48
May	62.8	109	30	1.02	.40	.24
Spring	58.0	109	27	6.37	1.97	19.17
June	68.2	110	39	.13	.01	.00
July	74.0	115	40	(1)	.00	.00
August	73.4	113	41	.03	.00	.00
Summer	71.8	115	39	.16	.01	.00
September	69.4	109	36	.35	.00	.41
October	62.6	99	30	1.14	(1)	1.20
November	54.4	94	19	2.76	.98	.00
Fall	62.1	109	19	4.25	.98	1.61
Year	60.0	115	19	25.60	10.32	50.17

[1] Trace.

AGRICULTURE

Agriculture in the Dixon area began with the arrival of the first white settler in 1842. Until that time the only inhabitants in this section were small scattered groups of Suisun Indians who did not practice even the most primitive form of agriculture. They were less belligerent than many of the valley tribes and certainly less so than their mountain neighbors. White men had undoubtedly traveled through their territory in earlier years, but none remained long enough to change the character of the landscape.

In 1842 William Wolfskill obtained from the Mexican Government a 4-league grant of land—the Rio de los Putos—located at the northern base of the English Hills and including the fertile alluvial soils on both sides of Putah Creek. The arrival of the Wolfskill family was followed (in 1843) by the settling of the Vaca and Pena families on the equally fertile Los Putos land grant to the southward. Subsistence farming and the raising of livestock constituted the first interests of these early settlers, with livestock raising rapidly becoming the more important industry. Until 1850 the increase in population was decidedly slow; "the whole valley around Vacaville was a range for the cattle of Vaca and Pena" (*8*).

That some increase in population was taking place is indicated, however, by the filing for record, December 13, 1851, of a plat for the proposed town of Vacaville. The first occupation of the later arrivals is reported to have been "the cutting of rank wild oats and transporting the same to points on the Sacramento River." The first crop of barley is said to have been grown near the present site of Elmira in 1853 and the first lot of fattened hogs to have been marketed there in 1854. Gold in small quantities was found on Putah Creek in 1860, which caused considerable excitement, but this soon subsided and many of the miners turned to farming.

Settlement was further stimulated by the construction of the Central Pacific Railroad. The towns of Dixon and Elmira sprang into existence in 1868 and became important shipping points for products that formerly had moved by water. Before the construction of the railroad, Maine Prairie (situated just south of the Dixon area, at the head of navigation on Cache Slough) was one of the more important grain-shipping points in the State (*8*).

> It was second to none except Stockton. Grain was drawn there for shipment with great teams and enormous wagons. One day in the year 1863 there were 36,800 pounds of wheat brought to the landing with one team. Three wagons were used to carry it. The grain was drawn a distance of 25 miles from the ranch of J. C. Carey on Putah Creek. In 1863 there were 50,000 tons of grain shipped from this point. It was no uncommon occurrence for 180 wagons to be seen in town in a single day, all loaded with grain, and each drawn by an 8- or 10-mule team.

The declining importance of Maine Prairie was noticeable by 1877, when it had 1 store, 1 hotel, 1 blacksmith shop, and 3 warehouses. Today (1931) it has 2 farmhouses and 1 large, infrequently used warehouse.

Agricultural development in the Dixon area was marked by the shift from cattle raising to grain farming, a movement that was State-wide and one which progressed most rapidly during the drought years of the early sixties. That grain farming had become

the dominant activity by the late seventies is evidenced by the 1876 report of the Solano County assessor. Of the 109,493 acres of cultivated land, 93,575 were reported planted to wheat and 15,819 to barley, and the number of horned cattle had decreased to 12,790 head compared to the 87,000 estimated to have been in the county 15 years previous. The growing interest in horticulture also is suggested by this report which notes 302,917 fruit trees of all kinds, producing a crop valued at $112,000, and 1,387 acres of grapes.

The areal distribution of these three major types of agriculture in 1877 was about the same as it is today. A contemporary map (*8*) roughly depicts this distribution and suggests that the livestock interests were competing unsuccessfully with grain farming for the better areas of the valley plain, and that both of these activities were giving way to horticulture on the fertile and more nearly frost-free lands along Putah Creek and in the foothill valleys.

By 1887, the Vacaville district was renowned as a producer of deciduous fruits, one observer writing:

> Vacaville is as much devoted to fruit as Waltham is to watches or Lowell to cotton spinning. All the fortunes in this section have been accumulated in this business and all the prospects for the future of 9 residents in 10 are bound up in it (*2*).

Approximately 15,000 acres of orchards and vineyards surrounded Vacaville, from which point 800 carloads of fruit had been sent to market in 1886. In his report for that year, the secretary of the California Fruit Union noted: "More than one-half of all the fruit shipped by the Union to eastern markets during the year came from Vacaville."

This early and notable development of horticulture in the Vacaville district was based primarily on local climatic advantages for profitable fruit production. Rainfall, supplemented by the run-off from adjacent elevated land, was sufficient for even the older orchards. It might be noted parenthetically that John R. Wolfskill spent several thousand dollars in 1857 for the installation of a steam engine and pump to irrigate his plantings along Putah Creek, only to abandon the endeavor a few years later as unnecessary. The warm winters and springs of this district promoted the early maturity of crops, allowing growers to profit by the higher, first-of-the-season prices. Cherries, apricots, peaches, plums, and other deciduous fruits are reported to have reached eastern as well as western markets from 2 weeks to a month earlier than shipments from other localities. When prices dropped, making the shipments of fresh fruit less profitable, Vacaville farmers successfully dried the remainder of their crop during the sunny days of the hot dry summer.

Since the late eighties, the agriculture of the Dixon area has been characterized by no striking or unusual developments. Two possible exceptions to this generalization occur: (1) The comparatively rapid establishment of a distinctive and intensive agriculture on the lowland along Sacramento River following the reclamation of this district by levee construction, and (2) the temporarily increased planting of certain crops, notably wheat, during and immediately following the World War. In general, however, the area devoted to deciduous-fruit orchards gradually expanded over the floor and adjoining foot slopes in both Vaca and Pleasants Valleys, eastward down Putah Creek to Tremont, and southward along the alluvial

ridges to the vicinities of Dixon and Batavia. Orchards and vineyards were set out on many of the gentler slopes of the English Hills and on the small alluvial fans of Sweeney, Ulatis, and Alamo Creeks. This gradual expansion of the orchard area out to the climatic or edaphic limits for successful fruit production was accomplished by a reduction in the acreage devoted to grain, despite the fact that much of the former grazing land was being broken for grain farming.

With an increased population, smaller farms, and the fencing of the former open range, sheep raising became the most profitable livestock industry, and today the beef cattle ranging on the mountain slopes and on the poorer lands of Yolo By-Pass are greatly outnumbered by sheep. Horticulture, dairying, mixed farming, and other types of intensive agriculture are now conducted on the more desirable and fertile areas, and wheat, which once covered the broad valley plain " in an almost unbroken expanse ", competes with barley and other small grains for the land of intermediate quality, and the days of the cattle baron and the bonanza wheat farmer are gone.

The changes that have occurred in the agriculture of Solano County during the last half century are shown in table 2 compiled from the reports of the United States census from 1880 to 1930, inclusive. Production figures are for the years immediately preceding the given census year.

TABLE 2.—*Selected data from United States census reports, 1880 to 1930, inclusive, Solano County, Calif.*

Item	1880	1890	1900	1910	1920	1925	1930
Farms:							
Number	1,016	1,213	1,151	1,143	1,358	1,522	1,479
Average acreage	402	356	417	415	301	243	291.7
Acre value...dollars	----------	----------	35.17	48.49	97.19	84.13	89.23
Population:							
Urban	5,987	6,343	10,716	11,340	23,800	----------	17,389
Rural	12,488	14,603	13,427	16,219	16,802	----------	23,445
Wheat:							
Acres	107,588	78,332	76,014	20,924	42,828	22,278	18,183
Bushels	2,042,533	1,756,837	1,990,680	391,753	1,035,049	453,428	401,392
Barley:							
Acres	32,222	29,057	51,069	41,647	35,979	22,863	46,561
Bushels	571,493	733,820	1,750,550	1,263,357	910,421	665,641	1,316,413
Hay, all kinds:							
Acres	23,237	30,169	31,256	39,664	32,101	28,147	21,746
Tons	29,124	38,993	51,900	56,987	66,327	48,946	49,894
Alfalfa:[1]							
Acres	----------	----------	1,676	2,145	7,831	6,221	7,001
Tons	----------	----------	4,254	10,617	33,863	----------	30,403
Apples:							
Trees	----------	5,681	15,648	4,862	5,979	5,287	2,182
Bushels	----------	3,761	19,600	6,857	17,341	8,645	[2] 66
Peaches:							
Trees	----------	302,041	428,027	341,266	214,412	241,896	203,562
Bushels	----------	235,648	575,062	474,444	387,904	391,755	[2] 6,772
Pears:							
Trees	----------	63,962	251,523	182,194	195,504	321,220	287,659
Bushels	----------	45,388	192,663	319,303	381,622	----------	[2] 9,568
Plums and prunes:							
Trees	----------	87,392	401,794	465,341	609,755	1,169,000	1,062,359
Bushels	----------	56,005	232,398	714,730	803,495	----------	[2] 9,183
Grapes:							
Vines	----------	----------	1,042,477	1,213,265	565,624	1,051,000	1,205,777
Pounds	----------	----------	6,994,200	16,276,990	4,210,057	----------	[2] 4,968
Horses and mules	8,526	11,899	10,502	10,369	7,052	5,644	3,412
Beef cattle	6,763	26,711	17,359	21,784	10,542	16,841	20,626
Dairy cattle	4,075				12,897		
Sheep	72,289	27,752	59,920	170,153	98,669	163,697	264,941

[1] Included in hay, all kinds.
[2] Tons.

SOILS AND CROPS

The 90-year period of settlement and agricultural development in the Dixon area has been characterized by a rather steady progress toward a definite alinement of the several types of agriculture to one or more of the elements of local environment. Economic conditions, either local or national, have at times affected the farming enterprises, but in the final analysis it has been the natural factors which primarily have been responsible for the success or failure of the farmers. Soil, climate, and such secondary factors as relief and drainage, constitute the chief limiting factors in crop production. As these are closely interrelated and as any notable change in one is reflected by some corresponding change in another,[8] it is difficult to evaluate exactly their individual importance.

Seven distinct groups, or complex arrangements, of the natural elements of local environment are present in the area. Their areal distribution approximates that of the seven already-mentioned physiographic subdivisions. In some adjacent groups some of the elements show only slight variations, but in others they are strikingly different. In general, the most pronounced and consistent differences are to be found in the soils. The soils are products of the environmental conditions and in their characteristics provide an index to the entire environmental complex and an interpretation of the agricultural activities.

As mapped, the soils of the Dixon area comprise 21 soil types (representing 13 soil series), 11 subordinate phases, and 3 groups of miscellaneous or undifferentiated materials.

The soil series is a group of soils having the same general character of profile development, closely related and similar in color, the same sequence in horizons, the same general conditions of relief and drainage, and a common or similar origin and process of accumulation of material from which development took place. It constitutes a group of soil units closely similar in all respects, except texture of the surface soil. A soil type is a soil which throughout the full extent of its occurrence has comparatively uniform texture of surface soil and comparatively uniform profile characteristics. It is the unit of soil mapping. A phase is a subdivision of the type, which covers departures from the typical soil characteristics, insufficient in character or extent to justify the establishment of a new soil type, yet worthy of recognition. Phase variations may cover color, texture, structure, relief, drainage, or any other feature of deviation from the typical (*6*).

For a discussion of dominant characteristics of the soil series represented in this area and of series relationships with detailed descriptions of some of the more representative soil types, the reader is referred to the section, Soils and Their Interpretation, on page 30.

Owing to the small extent of certain soils recognized as phases or undifferentiated inclusions, a few conflicts of very small extent and minor importance occur in joining this survey with the preceding survey of the Suisun area. Since the time of the much earlier surveys of the Woodland area (1909) and of the reconnaissance survey

[8] For a discussion of this interrelation, see Soils and Their Interpretation in a later part of this report.

of the Sacramento Valley (1913), during which much of the present-day science of soils and soil classification has been developed, and owing to the small scale and extensive reconnaissance character of mapping in the Sacramento Valley survey, apparent conflicts and discrepancies in classification with these earlier surveys are much more extensive and pronounced. The more important of these are noted and explained in the discussion of the individual soil types which follow.

In the following pages the soils of the Dixon area are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 3.

TABLE 3.—*Acreage and proportionate extent of soils mapped in the Dixon area, Calif.*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Hugo fine sandy loam	2,176	0.8	Capay clay, red phase	896	0.3
Hugo clay loam	4,288	1.5	Olcott fine sandy loam	13,312	4.8
Hugo clay loam, steep phase	1,792	.6	Olcott fine sandy loam, red phase	1,280	.5
Los Osos clay loam	3,712	1.3	Hartley fine sandy loam	3,520	1.3
Los Osos clay loam, steep phase	4,480	1.6	Hartley fine sandy loam, brown phase	640	.2
Denverton clay adobe	3,904	1.4	Solano fine sandy loam	768	.3
Yolo fine sandy loam	8,960	3.2	Solano fine sandy loam, brown phase	1,792	.6
Yolo fine sandy loam, shallow phase	4,544	1.6	Clear Lake clay adobe	20,800	7.5
Yolo silt loam	1,408	.5	Sacramento clay loam	26,368	9.5
Yolo silty clay loam	25,152	9.0	Sacramento clay loam, friable-subsoil phase	7,104	2.6
Yolo silty clay loam, calcareous-subsoil phase	5,120	1.9	Sacramento clay	10,496	3.8
Zamora silty clay loam	6,144	2.2	Columbia silty clay loam	2,688	1.0
Zamora clay loam	16,960	6.1	Denverton and Hartley soils, undifferentiated	4,928	1.8
Zamora clay loam, heavy-textured phase	320	.1	Los Osos and Hugo soils, undifferentiated, steep phase	20,672	7.4
Esparto silty clay loam	1,536	.5	River wash	256	.1
Esparto silty clay loam, light-textured phase	192	.1			
Capay loam	2,560	.9			
Capay clay loam	1,792	.6			
Capay silty clay loam	24,768	8.9	Total	278,400	------
Capay clay	43,072	15.5			

Hugo fine sandy loam.—The surface soil of Hugo fine sandy loam consists of a 12-inch layer of brown or rich-brown loose fine sandy loam. It is underlain, to a depth of not more than 30 inches, by darker brown or richer brown slightly compact fine sandy loam or loam which grades into yellowish-brown well-weathered sandstone. This soil has a low content of organic matter, although under virgin conditions the immediate surface layer is slightly darker and contains numerous plant remains. Both surface soil and subsoil—and to some degree the weathered sandstone also—are permeable to moisture, air, and plant roots. They have a comparatively low water-holding capacity, however, and have a noticeable tendency to bake in dry weather. Under cultivation, this soil is subject to severe erosion, and during each rainy season many tiny rills and rivulets evidence the removal of the upper soil material and the gradual exposure of the underlying materials.

Hugo fine sandy loam is not extensive, two bodies only being located in the English Hills. The southernmost of these is largely planted to deciduous fruits, with a smaller acreage in grapes. The sandy character of this soil and the better air drainage in this low

hilly area are both conducive to the early maturity of fruits. Although yields of apricots, peaches, and plums are somewhat below those obtained from orchards on the nearby soils, this is more or less compensated by the higher prices received for the earlier shipments. Ordinarily local precipitation suffices for a satisfactory tree growth, which is fortunate, as irrigation is impractical, owing to the elevation of this soil area. The northern area, lying near the junction of Pleasants and Putah Creeks, has not been so extensively planted, although the land affords essentially the same advantages. The most important problems confronting the farmers on this soil are the prevention of erosion and the maintenance of the organic-matter content.

Hugo clay loam.—Hugo clay loam is characterized by a 12-inch layer of grayish-brown clay loam underlain by more yellow and somewhat lighter colored compact heavy clay loam or clay. At a depth of not more than 30 inches the subsoil grades into light yellowish-brown well-weathered material of the underlying fine-textured sandstone. This soil has a slightly lower content of organic matter than the similarly-textured member of the Los Osos series, has a greater tendency to bake during dry weather, and, although it has approximately the same water-holding capacity, it is less well adapted for agriculture. It is also subject to severe erosion under cultivation, and the prevention of this form of soil destruction constitutes one of the more important problems confronting the farmers.

Hugo clay loam occurs in an almost continuous band along the eastern base of the Vaca Mountains, occupies the several low hills in Vaca Valley, and surrounds Dunns Peak in the nearby part of the English Hills.

Most of the southerly bodies are utilized in the production of grapes, apricots, plums, and other deciduous fruits, and the more northerly bodies are used chiefly for grazing livestock. This distribution of these two types of agriculture, especially the fruit-growing type, does not particularly reflect the adaptability of the soil, as the two types apparently have spread on this soil from nearby localities dominated by one or the other. Crops mature no earlier on Hugo clay loam than they do on Los Osos clay loam, and the yields are commonly somewhat lower on the Hugo soil.

Hugo clay loam, steep phase.—Hugo clay loam, steep phase, represents an intermediate condition between typical Hugo clay loam and the undifferentiated steep phase of the Los Osos and Hugo soils. It occurs on the more open grass-covered higher hills in the southern part of the Vaca Mountains and the English Hills. Because of its comparatively steep slopes, land of this kind cannot be profitably cultivated, and it is largely utilized for grazing livestock, to which use it appears to be better adapted.

Los Osos clay loam.—The surface soil of Los Osos clay loam consists of a 12-inch layer of brown or dark-brown sandy clay loam. It is underlain by slightly compact clay loam of similar or of slightly heavier texture and somewhat richer and darker color. At a depth of about 2 feet the subsoil grades into brown or light yellowish-brown well-weathered sandstone. This soil has good moisture-holding capacity and is, in general, well adapted for agriculture.

Los Osos clay loam is moderately extensive. A large body is in the central part of the English Hills, and several smaller bodies lie

north and south of the larger one. The larger central body is somewhat isolated, owing to its location and somewhat higher elevation, but it is extensively planted to orchards of deciduous fruits and to vineyards, the success of which is dependent on the same conditions as obtain on Hugo fine sandy loam. The smaller bodies in the northern part of the English Hills have been planted to orchards and vineyards to some extent, although much of their area is utilized for grazing. No trees or vines have been set out on the southern bodies, and these at present are used almost exclusively for the production of grain and for raising sheep—two agricultural industries which dominate the general district in which these bodies are located.

Two small areas included with this soil, situated at the southern boundary of the Dixon area, are continuations of bodies of Los Osos clay adobe mapped in the adjoining Suisun area. Typically, these are clay adobe soil, but because of their small size their separation as a distinct soil type was not justified in this area.

Los Osos clay loam, steep phase.—Los Osos clay loam, steep phase, differs in no essential respect, except in relief, from typical Los Osos clay loam. For the most part the land is open and parklike, but it occupies slopes too steep for successful cultivation and usually occurs at the higher elevations in the English Hills and Vaca Mountains. It represents an intermediate condition between typical Los Osos clay loam and the steep phase of the Los Osos and Hugo soils, undifferentiated, being distinguished from the latter by its less rugged relief and its more open grass-covered character. The northeastern part of the large area at Putnam Peak in the English Hills and the two smaller bodies near Putah Creek have developed from a conglomerate formation rather than from the sandstone which in most places underlies the soil of this phase. These areas are characterized by a high content of well-rounded quartzitic gravel and small cobbles. Most of this steep land is being utilized successfully for grazing livestock, and a few small plantings of grapes, apples, and pears have been set out in the more favorable situations.

Denverton clay adobe.—Denverton clay adobe consists of dark-brown or dark rich-brown clay having an adobe structure, underlain at a depth ranging from 10 to 18 inches by brown or light grayish-brown compact sandy clay containing numerous fragments and nodules of lime. At a depth ranging from 2 to 3 feet below the surface the subsoil grades into a light grayish-brown or light yellowish-brown calcareous partly consolidated substratum of old sedimentary deposits. The surface soil is moderately well supplied with organic matter, and, despite the high content of clay, tillage operations are not particularly difficult if the soil is handled at the proper degree of moisture content. Plowing commonly is performed when the soil is slightly dried, and with further drying it breaks into small angular fragments and granules, producing a satisfactory tilth. Both surface soil and subsoil have a comparatively high water-holding capacity, absorb moisture readily, and offer little hindrance to the ready penetration and development of plant roots. This soil is less subject to severe erosion than are the several members of the Los Osos and Hugo series, probably because a larger part of the precipitation is absorbed.

Denverton clay adobe occurs in a large number of small scattered bodies along the eastern margin of the English Hills, the

southernmost being in the vicinity of Vacaville and the northernmost adjoining the channel of Putah Creek. A number of these areas differ to some degree from the typical soil, apparently depending on the extent to which an admixture of materials from adjacent bodies of other soils has taken place or on the extent and character of erosion to which the land has been subjected. More than 50 percent of this soil, especially the lower lying bodies, is under cultivation, with grapes, plums, apricots, and other deciduous fruits constituting the dominant crops. The remainder is used chiefly for winter grazing of sheep. The production of fruits on this soil in the Dixon area is in marked contrast to the use of the same soil in the nearby Suisun area, where Denverton clay adobe is of extensive occurrence in the Montezuma Hills. In that area the growing of wheat and barley is dominant, and the production of fruit is impractical, owing to the almost daily occurrence of strong summer winds blowing in from the ocean through Carquinez Strait. With greater rainfall, comparatively higher temperatures, and protection from these winds provided by the western mountain barrier, Denverton clay adobe in the Dixon area is better adapted to orchards and vineyards, and fruit production has proved more profitable than grain farming.

Yolo fine sandy loam.—Yolo fine sandy loam, as occurring in the Dixon area, is somewhat variable in character. The more typical areas consist of freshly deposited alluvial material without any appreciable modification in character of profile through agencies of weathering, but as mapped here the soil includes areas in which incipient development of a profile has taken place, as indicated by a very slightly compacted upper subsoil layer, in which the soil aggregates are stained by dark-colored colloidal material.

The more recently deposited unmodified materials, extending to a depth of 6 feet or deeper, consist of comparatively structureless loose fine sandy loam which ranges in color from brown or grayish brown in the surface soil to light brown or light grayish brown in the subsoil. Being essentially a recent deposit of alluvial origin, in some places the soil may contain subsurface strata of slightly different textures. The organic-matter content ranges from medium to low, particularly in the subsoil, and the moisture-holding capacity is rather low, but the pervious character of the entire soil mass promotes good drainage and allows ready penetration of plant roots. Cultivation presents no special difficulties, good tilth is easily maintained, and if planted to deep-rooted crops, or if irrigation is practiced, this soil is one of the more productive soils in the area.

The older materials, which have been slightly modified in place, consist of a 12- to 18-inch layer of brown or grayish-brown friable fine sandy loam overlying a slightly darker and denser upper subsoil layer which is in general of slightly heavier texture. This layer rests, at a depth ranging from 40 to 50 inches, on brown or light yellowish-brown loose porous material similar to the surface soil in texture. Most of the areas of this older soil occupy the crests of slightly elevated stream ridges and are marked by excellent drainage conditions. Although of less loose character than the areas of more recent accumulation, the entire soil to a depth of 6 feet is permeable, and the penetration of roots, air, and moisture is comparatively free. The upper subsoil layer, being slightly denser and

of heavier texture, has a somewhat higher water-holding capacity, and the soil is adapted to an extremely wide range of intensively grown crops. Locally, it is regarded as being of high agricultural value.

An almost continuous band, about 25 miles long, of the looser Yolo fine sandy loam extends along Putah Creek between Vaca Mountains and the Yolo By-Pass. An inextensive narrow strip bordering Alamo Creek lies south of Vacaville. Both these bodies are dominated by an intensive type of agriculture. Practically all the southern body and the greater part of the northern one are planted to apricots, peaches, plums, and other deciduous fruits. On the crest of Putah Creek Ridge, in the vicinity of Winters, is a local thermal belt, within which are located the 2 or 3 small citrus groves of the area. The eastern part of this northern body is characterized by lower winter temperatures, however, and is utilized mainly for the production of sugar beets, lettuce, beans, and similar crops, for grain and forage, and for pasturing livestock, which is conducted chiefly in the easternmost part of this body, where inundations are more frequent and the deposition of material is somewhat more rapid.

The older and slightly weathered areas are most extensive in the northeastern part of the piedmont-plain division, although a number of small bodies occur at such widely separated points as the eastern end of Putah Creek, along Alamo Creek east of Elmira, along Sweeney Creek west of Allendale, and in both Vaca and Pleasants Valleys. The southern and the western small bodies are almost exclusively planted to deciduous fruits; that at the eastern end of Putah Creek is used for the production of forage as a part of the livestock industry mainly conducted on the adjacent areas of poorer soils; and the more extensive areas lying between Dixon and Winters are used intensively for various crops. In the vicinity of Dixon, where dairying and mixed farming prevails, the soil is largely planted to alfalfa, wheat, barley, and other forage and grain crops; near Winters, deciduous fruits are the dominating crops; and in the intermediate localities all the crops mentioned are grown.

Yolo fine sandy loam, shallow phase.—Yolo fine sandy loam, shallow phase, is essentially a shallow surface deposit of Yolo fine sandy loam overlying a member of the Olcott, Capay, or Clear Lake series. In most places the surface soil is about 3 feet thick, although it ranges from less than 2 feet in some places to more than 4 feet in others, depending on the distance from the stream which has transported the material and on other local conditions. The presence of a comparatively impervious clay layer in the lower material interferes with root penetration and impedes the movement of subsurface waters; therefore soil of this phase is not so well adapted to many of the more intensive crops as is the typical soil.

The more extensive bodies of Yolo fine sandy loam, shallow phase, are near South Fork Putah Creek, and they represent the thinner and more distantly transported recent deposits of that stream. The western body is mainly underlain by Capay material and is utilized principally for grazing livestock, although a small part of it has been planted to orchards. The eastern body is underlain by the dark-gray heavy clay of the Clear Lake soils and in most places is less than 3 feet thick. It is used during both summer and winter

for grazing livestock, chiefly cattle, which are removed to higher ground at the beginning of the rainy season. In the winter this body is leased as a duck-hunting preserve to a local gun club.

Smaller areas of this shallow soil, associated with Olcott fine sandy loam, are in the western part of the piedmont plain, extending from the vicinity of Elmira northward. These areas are narrow strips of recent alluvium that has been deposited by local streams along the more nearly flat stretches of their channels. The southern bodies along Alamo and Ulatis Creeks and the northern bodies along Sweeney Creek are planted to some extent to deciduous fruits, and the intermediate areas are used chiefly for the production of grain and forage and for pasturing sheep, to which the soil is very well adapted.

Some of this soil in the vicinity of Putah Creek is coextensive with an area mapped as river wash in the earlier survey of the Woodland area. This material has apparently been greatly changed and modified in character by deposition of alluvial material transported by the stream since the time of the earlier survey.

Yolo silt loam.—Yolo silt loam differs from the fresher unmodified material of Yolo sandy loam in no essential respect other than texture. In most places, to a depth of 6 or more feet, it consists of comparatively structureless loose silt loam having a brown or grayish-brown color at the surface and becoming somewhat lighter colored with depth, but in certain places it may contain subsurface strata of slightly different textures. Owing to a larger proportion of finer soil particles, the silt loam has a higher water-holding capacity and is edaphically better suited for the intensive agricultural activities of the general region.

This soil is inextensive, five bodies occurring in association with Yolo fine sandy loam at the lower eastern end of Putah Creek and its distributary channels. The somewhat lower winter temperatures of this locality are disadvantageous for fruit growing, and these bodies of Yolo silt loam are mainly utilized for the production of lettuce, beans, sugar beets, and similar crops, for the production of forage and grain, and for pasturing herds of purebred sheep and cattle.

A very small area joins with Yolo fine sandy loam of the Woodland area, into which it grades.

Yolo silty clay loam.—Yolo silty clay loam is essentially the same as the older and slightly modified areas of Yolo fine sandy loam, with the exception of a somewhat heavier texture. It consists of a 12- to 18-inch layer of brown or dark grayish-brown friable silty clay loam overlying slightly darker and denser heavy material which rests, at a depth ranging from 40 to 50 inches, on brown or light yellowish-brown loose fine sandy loam or loam. Although occupying the gently sloping sides of the stream ridges and, in some places, extending well out on the more nearly flat parts of the plain, this soil is characterized by good drainage. Owing to a larger proportion of the finer soil particles, it has a higher water-holding capacity than Yolo fine sandy loam. It also has a somewhat greater content of organic matter and offers the same ready penetrability to plant roots, air, and moisture. Yolo silty clay loam is classed by many farmers as the best agricultural soil in the area, as it is adapted to a wide range of intensive uses and has very few and unimportant

cultural difficulties. Its productiveness, however, might be increased somewhat through the addition of organic matter, either by applications of barnyard manure or by growing cover crops when the moisture supply is sufficient.

Yolo silty clay loam is one of the more extensive and widely distributed soils in the Dixon area. Associated with Yolo fine sandy loam, it constitutes the principal soil in the district of pronounced stream ridges, which extends from the vicinity of Dixon northwestward to Putah Creek. Large bodies of this soil occur in several other parts, the more important being in Vaca Valley, on the alluvial fans east of Vacaville, bordering Putah Creek, on the ridge east of Tremont, and on the ridges east and southeast of Dixon. Some smaller areas occur in Pleasants Valley, on the fan of Sweeney Creek, and in other well-drained localities. Because of its wide distribution and its suitability for a variety of purposes, Yolo silty clay loam is utilized differently in different parts of the area. Where the climate is favorable, the soil is planted chiefly to deciduous fruits, and fruit production is dominant in the northwestern part of the piedmont-plain division, in Pleasants and Vaca Valleys, and in the vicinity of Vacaville. About Dixon, also on the bodies near Putah Creek and east of Tremont, the soil is used both for fruit growing and for mixed farming. South and east of Dixon, grain and forage production, in association with sheep raising, are the dominant activities. In general, each of these forms of utilizing Yolo silty clay loam reflects the most satisfactory use of this widely adapted soil under the climatic and other nonedaphic environmental conditions that prevail in each of the several localities of its occurrence. Two very small bodies, having a brownish-gray or light brownish-gray color, lie south of Vacaville at the boundary of the area. These are parts of larger bodies of Yolo silty clay loam, gray phase, which were mapped in the Suisun area, but they are of insufficient extent to justify their differentiation in this area. Both are used chiefly for sheep pasture, although they are occasionally planted to a grain crop.

As mapped this soil includes two comparatively small bodies of somewhat heavier texture than typical. The larger lies about 2 miles south of Dixon and the smaller 4 miles northwest of that town. Both are used mainly for mixed farming.

Yolo silty clay loam, calcareous-subsoil phase.—Yolo silty clay loam, calcareous-subsoil phase, is similar in many respects to typical Yolo silty clay loam, the essential difference between the two soils being the presence of lime in the lower subsoil layer, or substratum, of the phase. Soil of this phase consists typically of a 12- to 20-inch layer of dark dull-brown or dark grayish-brown friable silty clay loam underlain by slightly darker and denser material which, at a depth ranging from 40 to 54 inches, grades into brown or light yellowish-brown calcareous material of lighter texture and looser consistence. The bodies of this soil occupy the gently sloping stream ridges and are characterized by satisfactory drainage. The soil has good water-holding capacity and a moderate content of organic matter. As it is friable throughout, it is readily penetrated by plant roots, moisture, and air and presents no important cultural difficulties. The soil is well adapted for the production of a wide variety of intensive crops.

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The calcareous-subsoil phase of Yolo silty clay loam is extensive in the central part of the piedmont-plain division, where a number of bodies occur, ranging in size from less than 80 to more than 1,500 acres. Most areas of this soil occur in association with members of both the Capay and Yolo series, and, although the soil approaches the Yolo soils in character, it probably represents an intermediate condition between the Capay and Yolo soils. Where a supply of water is available for irrigation, the soil is well adapted to the production of alfalfa, and the greater part of the land is planted to this and other forage crops. Some wheat and barley are grown, and a very small part is planted to orchards of deciduous fruits and to vineyards.

As mapped in the area, this soil includes four comparatively inextensive bodies in the immediate vicinity of Dixon. These included bodies are of slightly heavier texture than the typical areas. They occupy the upper and better drained parts of the interridge troughs. Because of their situation they are subject to somewhat cooler growing conditions than the lighter textured areas, but the soil here has greater water-holding capacity and a slightly higher content of organic matter. These areas are used mainly for the production of forage and grain crops and, to less extent, for pasturing small herds of sheep and cattle.

Zamora silty clay loam.—The surface soil of Zamora silty clay loam consists of a 12- to 18-inch layer of brown or dark grayish-brown friable silty clay loam. It is underlain by denser and slightly darker material of similar or slightly heavier texture, which grades into brown or light yellowish-brown looser material at a depth ranging from 30 to 40 inches. This soil is moderately well supplied with organic matter, presents few cultural difficulties, and is easily penetrated by plant roots, air, and moisture. It is well suited to all the more intensive forms of agriculture that are practiced in this general region.

Zamora silty clay loam is of only moderate extent, although it occurs in many widely separated bodies, chiefly in the northwestern half of the piedmont plain and in Vaca Valley. In Vaca Valley and on the alluvial fans east of Vacaville the soil is planted predominantly to deciduous fruits. Comparatively large yields are commonly obtained from these plantings, although the fruit ripens at a somewhat later date than in orchards occupying the nearby elevations. Throughout the rest of the areas the soil is used largely for the production of grain and forage, for pasturing livestock, and for mixed farming, to all of which it is well adapted.

Zamora clay loam.—Zamora clay loam is characterized by a 12- to 20-inch layer of dull-brown or dark grayish-brown clay loam underlain by darker and denser heavy clay loam or clay, which extends to a depth ranging from 3 to 4 feet, where it grades into brown or light yellowish-brown clay loam or clay.

Cultural operations on this soil are somewhat more difficult than on the lighter textured Zamora soil, but Zamora clay loam has a greater content of organic matter and a higher water-holding capacity. Owing to its tighter and less permeable upper subsoil layer, as well as to its occurrence in more nearly flat areas, this soil is only moderately well drained, and the lower part of the subsoil is faintly mottled with the red and gray staining associated with restricted drainage and aeration.

Zamora clay loam is similar to Zamora silty clay loam, both in extent and distribution. Many widely scattered bodies occur between the stream ridges in the northwestern half of the piedmont plain, on the alluvial fans and valley floors in the English Hills, and in Vaca and Pleasant Valleys.

Most of the bodies are brown or grayish brown, which is typical of the Zamora soils. In the narrow valleys of the English Hills, however, a reddish-brown color predominates, owing to the addition of material eroded from the redder primary soils on the adjacent elevations. At the southern end of the English Hills, about 2 miles north of Vacaville, two bodies of this soil are darker grayish brown than typical. The variation from the typical color in these two areas apparently represents the influence of slightly impeded drainage on materials washed down from nearby and higher lying bodies of dark-brown soils.

All the Zamora clay loam, regardless of color variations, is used for the same crops—deciduous fruits and vineyards being planted on most of the land, especially in the localities having favorable climatic conditions. Mixed farming and the production of wheat and barley are the leading enterprises on most of the more easterly bodies.

Zamora clay loam, heavy-textured phase.—Zamora clay loam, heavy-textured phase, represents the clay adobe type of the Zamora series, but, because of its very small extent, it is included as the heavy-textured phase of Zamora clay loam. This soil consists of a 15-inch layer of dark-brown clay having an adobe structure, overlying heavier and rather compact clay which, at a depth ranging from 30 to 40 inches, grades into brown or light-brown rather loose and noncalcareous lighter textured clay.

Soil of this phase occurs in several small bodies scattered around the margin of the English Hills and in one very small body near the upper part of Laguna Creek Valley. The western areas are planted to deciduous fruits, plantings of which are extensive on the adjoining Yolo and Zamora soils. The eastern bodies are utilized mainly for the production of grain, a use to which they probably are better adapted in these localities, owing to climatic conditions.

Esparto silty clay loam.—The surface soil of Esparto silty clay loam consists of a 12- to 20-inch layer of light grayish-brown friable silty clay loam. It overlies compact light-brown or light grayish-brown heavy silty clay loam which extends to a depth ranging from 3 to 4 feet and grades into light-brown loose material of similar texture, slightly mottled with reddish-brown and yellowish-brown stains. This soil has a moderately high water-holding capacity, a fair content of organic matter, and is well suited for the production of deciduous fruits and other agricultural crops.

This soil is not extensive. It occurs in several comparatively small bodies along the western sides of Vaca and Pleasants Valleys, where it apparently represents a deposit of materials washed down from adjacent and higher lying bodies of Hugo soil. Orchards of plums, peaches, apricots, and other deciduous fruits occupy practically all the bodies in Vaca Valley. The yields appear to be satisfactory, although they are not so large and no earlier than on adjacent soils. The centrally located body in Pleasants Valley is used to only a slight extent for agricultural purposes, the part lying east of the

main road being planted to orchard fruits and that west of the road remaining largely in a virgin condition.

Esparto silty clay loam, light-textured phase.—Esparto silty clay loam, light-textured phase, has a 12- to 18-inch layer of friable light grayish-brown fine sandy loam underlain by compact light-brown or light grayish-brown heavy fine sandy loam which grades, at a depth ranging from 3 to 4 feet, into light-brown fine sandy loam having a faint mottling of reddish-brown and yellowish-brown stains. Soil of this phase has a comparatively low content of organic matter, a low water-holding capacity, and tends toward an acidic reaction in both surface soil and subsoil. It is not particularly well suited to the growth of deciduous trees, and no mature orchards are growing on it. It is of very small extent—only three small bodies, all occurring along the western side of Vaca and Pleasants Valleys, being mapped. The northern and largest of these forms part of an enclosed grazing area for cattle, the central one has recently been planted to grapes and a small orchard of deciduous fruits, and the southernmost body is largely unused for agriculture.

Capay loam.—Capay loam consists of a 6- to 16-inch layer of dark dull-brown or dark grayish-brown heavy-textured loam overlying comparatively dense and compact dark grayish-brown clay loam or clay, which, at a depth ranging from 20 to 40 inches, grades into light-brown or light yellowish-brown looser and slightly lighter textured material containing disseminated lime. This soil has a moderate content of organic matter, good water-holding capacity, and is fairly permeable to moisture, air, and plant roots. Subdrainage ranges from fair to slightly restricted.

Capay loam is not extensive, although several small bodies occur in widely separated localities of the piedmont-plain division, the largest of which are in the vicinities of Vacaville and Elmira, on the alluvial fan of Alamo Creek. A small part of each of these bodies is planted to deciduous fruits, chiefly prunes, and the remaining parts, as well as the other areas, are used for the production of grain and for pasturing livestock.

Capay clay loam.—The 15- to 30-inch surface soil of Capay clay loam consists of dull grayish-brown friable clay loam. It is underlain by denser material of similar texture, which, at a depth ranging from 3 to 5 feet, grades into an underlying light-brown or light yellowish-brown looser material of similar or lighter texture, containing moderate quantities of disseminated lime. This soil has a fair content of organic matter; is readily penetrated by roots, air, and moisture; has a slightly higher water-holding capacity than Capay loam; and subdrainage likewise is somewhat restricted.

Bodies of this soil occur on the lower side slopes and on the tips of the stream ridges, generally occupying intermediate positions between bodies of Yolo soils and the heavier members of the Capay series. In its value for agricultural purposes, this soil occupies an intermediate position, as it is not so well adapted for a variety of crops as is Yolo silty clay loam, and it is not so restricted in utility as are the heavier textured members of the Capay series.

Capay clay loam is not extensive, only six bodies being mapped. The largest of these extends northwestward from Binghampton on the lower end of Dixon Ridge, two areas occupy the western slope

of this same ridge about 3 miles west of Dixon, the fourth body occurs 5 miles east of Tremont at the top of the stream ridge which passes through that place, the fifth is at Elmira, and the sixth is south of Vacaville. All this land is used for the production of grain and forage crops, including small acreages of alfalfa.

Capay silty clay loam.—To a depth ranging from 6 to 18 inches, Capay silty clay loam consists of dull-brown or grayish-brown somewhat friable silty clay loam. It is underlain by comparatively dense and compact dark grayish-brown silty clay or clay, which, at a depth ranging from 3 to 4 feet, grades into light-brown or light yellowish-brown very slightly compact silty clay or clay loam, containing a few small calcareous concretions and some disseminated lime and being slightly mottled with rust-brown, gray, and yellow stains.

This soil has a moderate content of organic matter and a comparatively high water-holding capacity. Owing to its rather fine texture and the greater compaction of the upper part of the subsoil, it is not penetrated by roots, air, and moisture so readily as is Capay clay loam. Despite its heavier texture, however, this soil is easily worked into a fine-granular condition favorable to plant growth. Where not cultivated, the soil has a tendency to crack and check on drying, the cracks extending in some places to a depth ranging from 2 to 3 feet, which hastens the rate of desiccation.

Owing to its occurrence in localities of rather flat relief and to its slow permeability, Capay silty clay loam is characterized by poorly developed subdrainage, and during periods of heavy precipitation most of the land is subject to shallow inundation. This condition, augmented by the restricted subdrainage, is probably the chief limiting factor in the agricultural utilization of the land. To meet this difficulty the farmers in the neighborhood of Elmira plow their fields in the same narrow strips year after year, turning the earth in toward a central back furrow. The troughlike depressions of the dead furrows between the strips serve as shallow drainageways for the removal of excess surface water from the higher lying central parts of the strips.

Capay silty clay loam is one of the more extensive soils in the Dixon area, many fairly large bodies occurring throughout the greater part of the piedmont-plain division. The northern and western bodies occupy low interridge positions, although a few nontypical areas occur as narrow bands along the small streams, and in these a comparatively heavy admixture of recent alluvium has caused the character of the surface soil to approach that of the Yolo soils. Most of the eastern bodies of Capay silty clay loam have a more nearly flat relief and, although they lie very slightly higher than the associated bodies of Capay clay, they are marked by a condition of restricted drainage.

Although a few small plantings of pears, prunes, and other fruits have been set out on some of the western areas, this soil is predominantly used in the production of wheat and barley and for pasturing sheep. Yields of grain differ greatly from season to season, depending on local climatic conditions, the larger yields commonly being obtained in years of moderate or low rainfall. In unusually wet years, the crop generally drowns out unless the measures described for the removal of surface water are adopted.

Capay clay.—The surface soil of Capay clay consists of a 6- to 18-inch layer of dark dull-brown or dark grayish-brown clay. It is underlain by denser and darker clay which, at a depth ranging from 3 to 4 feet, grades into brown or light grayish-brown silty clay or clay, containing numerous calcareous concretions, disseminated lime, and, in a few places, lenses of crystalline gypsum.

Owing to its high content of clay, this soil is sticky and tenacious when wet and tough and hard when dry. If plowed in the early part of the rainy season, when the soil has been slightly moistened, it is only a little more difficult to handle than Capay silty clay loam. It is well supplied with organic matter and has a very high water-holding capacity, although moisture is slowly absorbed and slowly given up, and crop yields are commonly very low in dry years. This low-lying soil is characterized by poorly developed drainage, and crops may be drowned out in years of heavy precipitation.

Capay clay is one of the more extensive soils, although its distribution is more restricted than that of Capay silty clay loam. It is the dominant soil in the southeastern part of the piedmont-plain division, where it occupies two-thirds or more of the total land surface. It joins with Capay silty clay loam, heavy-textured phase, of the Suisun area, which represents Capay clay but was included with the silty clay loam in that area because of its inextensive occurrence.

Several small bodies lie near Elmira and northward along the eastern edge of the English Hills. These bodies are devoted chiefly to the production of wheat and barley, both for hay and grain, to which the soil seems well suited. Grain growing and sheep pasturing are about equally important on the remaining areas, grain growing being the more important on the centrally located bodies and sheep pasturing on the eastern areas.

Capay clay, red phase.—Capay clay, red phase, differs from typical Capay clay in two essential respects—it has a redder color and slightly better drainage. To a depth ranging from 12 to 27 inches this soil consists of rich-brown or reddish-brown clay which overlies denser and somewhat more red clay that grades, at a depth ranging from 40 to 50 inches, into light reddish-brown or light yellowish-brown calcareous silty clay or clay. Only two bodies of this soil occur, both in the northwestern part of the piedmont-plain division about midway between Dixon and Wolfskill. A slightly higher elevation and a steeper gradient at this place account for the better drainage, and the proximity of higher lying bodies of the reddish-brown Hartley soils suggests an explanation for the richer brown color. Both these bodies are used successfully for the production of wheat and barley, mainly for grain, although in years of low rainfall the crops are cut for hay.

Olcott fine sandy loam.—The surface soil of Olcott fine sandy loam consists of rich-brown or light-brown friable fine sandy loam, abruptly changing, at a depth ranging from 15 to 20 inches, to dense heavy clay having a darker brown and richer brown color. The subsoil, at a depth ranging from 3 to 4 feet, grades rather abruptly into a light yellowish-brown somewhat massive sandy clay loam or sandy clay substratum that in most places is slightly mottled with gray and rust-brown stains.

The surface layer of this soil has low water-holding capacity, and the content of organic matter is small. It is readily penetrated by moisture, air, and roots, and cultural operations are not particularly difficult. In contrast, the subsoil is plastic and massive when wet, and hard and prismatic when dry. Its tight impervious character retards the movement of moisture and air and materially impedes the penetration of plant roots, so that root development is practically limited to the upper soil layer which is saturated and boggy in periods of heavy rainfall, but which becomes very dry during the hot summer season. The profitable use of this soil for agriculture, therefore, is mainly restricted to growing such crops as fall-sown grains, supplemented by the grazing of livestock. The yields differ with climatic conditions, the heavier yields commonly being obtained in years of normal precipitation.

Olcott fine sandy loam is one of the more extensive soils in the Dixon area. With the exception of three small bodies near Binghamton, it occurs only in that part of the piedmont-plain division lying between the English Hills and Dixon Ridge. In this locality of nearly flat relief, surface drainage is benefited somewhat by the numerous slightly entrenched streamways, and many of the grain farmers have adopted the same plowing practice as that in use on Capay silty clay loam. A few small orchard plantings of mixed fruits, grown mainly for home needs, have been made on this soil, but the yields of fruit are rather low, although the quality is good.

Olcott fine sandy loam, red phase.—Olcott fine sandy loam, red phase, has the same " two-storied " profile as the typical soil, but it differs from that soil in color. It consists of light reddish-brown loose fine sandy loam to a depth of about 18 inches, changing abruptly to rich-brown tight comparatively impervious clay which extends to a depth of about 3 feet, where it is underlain by a light-brown very slightly mottled compact sandy clay substratum.

Soil of this phase is not extensive, a few small bodies occurring along the eastern base of the English Hills in close association with areas of Hartley and typical Olcott soils. Soil of the red phase commonly occupies slightly more elevated and more sloping positions than typical Olcott fine sandy loam, and it has better aeration and drainage, but the content of organic matter is somewhat lower. In degree of development this soil is more or less intermediate between the two associated soils, and it is also intermediate in agricultural value. With the exception of two small southern bodies, which are planted to apricot and plum orchards, all the land is used for the production of grain and for grazing sheep.

Hartley fine sandy loam.—Hartley fine sandy loam, like the Olcott soils, is a " two-storied " soil. It consists of a layer of light brownish-red friable fine sandy loam from 18 to 27 inches thick, which changes abruptly to tight and compact brownish-red clay resting, at a depth ranging from 3 to 4 feet, on light reddish-brown rather massive clay loam or clay. Well-rounded gravel and cobbles commonly occur as strata in the lower part of the soil mass and in some places are scattered over the surface and distributed throughout the entire thickness of the soil. Like Olcott fine sandy loam, the surface soil is low in organic matter and has poor water-holding capacity. The impervious subsoil tends to restrict root growth to the upper soil

layer which is typically well drained and aerated during the greater part of the year, although it may be saturated and boggy for short periods after the heavier rains. Owing to its more sloping surface and slightly higher elevation and the resulting better aeration and drainage, this soil is adapted to a wider range of agricultural activities than is the corresponding member of the Olcott series.

Hartley fine sandy loam is of moderate extent. A number of bodies occur in an interrupted band along the eastern and northern bases of the English Hills, and two small isolated areas are in the central part of these hills.

The greater part of the land is utilized in the production of grain and for grazing sheep. A number of small orchards and vineyards have been planted, especially on the more western bodies, but these have not proved very successful. On a larger body near Hartley, where an important small-farm subdivision was started several years ago, the struggling and, in some places, abandoned orchards show the inadvisability of planting trees and other deep-rooted crops on this soil.

Hartley fine sandy loam, brown phase.—To a depth ranging from 12 to 20 inches, Hartley fine sandy loan, brown phase, consists of friable light reddish-brown fine sandy loam which changes abruptly to tight and compact reddish-brown clay that becomes less compact, lighter textured, and more yellow with increased depth. In a few places the lower part of the subsoil contains small accumulations of lime. Soil of this phase is inextensive, although many comparatively small bodies occupy the low hills and ridges scattered over the piedmont plain from the vicinity of Hartley to the vicinities of Elmira and Binghamton. These low hills, representing remnants caused by erosion of an ancient alluvial deposit, are surrounded by extensive areas of less well drained soils which are chiefly devoted to grain farming and sheep raising, and they offer desirable sites for the houses and other farm buildings. Numerous small home orchards are successfully grown on this soil, although the land is predominantly used in the production of grain and forage.

Solano fine sandy loam.—Solano fine sandy loam is the third of the " two-storied " soils in the Dixon area. It is characterized by a 24-inch layer of light brownish-gray or pale yellowish-gray loose fine sandy loam which changes abruptly to tight and compact dull yellowish-brown or grayish-brown heavy clay. At a depth ranging from 3 to 4 feet, the material gradually becomes less compact, sandier, and of light-yellow color. The lower part of the subsoil is calcareous, the lime being not only disseminated throughout the subsoil mass but occurring also in zones and spots of high accumulation. In a few bodies, numerous small calcareous concretions are present. The land is poorly drained and commonly contains more or less alkali. This is, in fact, the only soil in the area which contains extensive developments of salt efflorescence. The surface soil has a very low content of organic matter and in most places shows a marked tendency to run together and puddle, although it improves in tilth under continued cultivation and works down to a fine-granular condition. As in the Hartley and Olcott soils, the heavy and impervious subsoil limits root growth largely to the surface soil. For the reasons stated, this soil is poorly adapted to crops, its principal value being in the grazing it affords.

Solano fine sandy loam is of very small extent, only four small areas along the eastern margin of the piedmont plain having been mapped. They have a hummocky surface configuration (pl. 1, B) and join with a hummocky phase of this soil of the Suisun area. This condition apparently results from an incomplete stripping of the surface soil by erosion, as at the crests of the hummocks the fine sandy loam layer is of maximum thickness, and in the inter-hummock troughs it is very thin. The plane separating the surface soil and subsoil is smoothly sloping in marked nonconformity to the land surface. All this land is used for grazing sheep.

Solano fine sandy loam, brown phase.—The surface soil of Solano fine sandy loam, brown phase, consists of a 12- to 24-inch layer of loose light-brown fine sandy loam which changes abruptly to tight and compact brown or rich-brown heavy clay. This material grades, at a depth ranging from 30 to 48 inches, into light-brown or light grayish-brown less compact and lighter textured calcareous clay. As in typical Solano fine sandy loam the calcareous lower subsoil layer contains not only disseminated lime but also zones and spots of greater concentration, including a few small hard concretions.

Soil of this phase is of slightly greater extent, of wider distribution, and of somewhat higher agricultural value, than typical Solano fine sandy loam. A number of small bodies lie along the eastern margin of the piedmont plain, and a few occur in association with Olcott fine sandy loam north of Elmira. This brown soil is slightly better drained than the typical soil and shows no evidence of alkali. A small part of the land, especially in the western areas, is used for grain production, but most of the soil is utilized for grazing sheep, to which use it is better adapted than the typical soil.

Clear Lake clay adobe.—The surface soil of Clear Lake clay adobe, where typically developed, consists of dark brownish-gray, dark-gray, or black heavy clay from 15 to 20 inches thick, which grades imperceptibly, through a more compact zone of similar color and texture, into light brownish-gray calcareous clay or sandy clay. The surface soil is sticky and plastic when wet, but on drying it cracks with the deep fissures and clods of a typical adobe soil. If plowed when only slightly moist, it breaks down to a fine-granular structure favorable to plant growth. This soil absorbs and releases moisture very slowly, and, despite its high water-holding capacity, crops planted on it are apt to suffer from lack of water during the hotter and drier periods. The land is subject to poor drainage, owing to its occurrence in the lower and flatter situations, but it has a comparatively high content of organic matter, and in spite of the problems and difficulties involved in its use, it is adapted to a variety of annual crops if a proper farming program is followed. As mapped this soil includes three minor variations which bear a close similarity to one another.

Typical Clear Lake clay adobe is extensive. In addition to a few very small bodies in Vaca Valley and vicinity, the soil occurs as a broad band along the western side of the Yolo By-Pass and as numerous narrow strips in adjacent parts of the piedmont plain. The western areas are largely under cultivation, and, in addition to one or two small plantings of pears, they are used predominantly for grain farming. The narrow bodies to the east are used both for

grain production and for grazing, and a portion of the southern part of the large area along the Yolo By-Pass, which has been protected for the last few years by a levee, is being successfully cropped to sugar beets. The rest of this area, being subject to inundation each rainy season, is practically restricted to summer grazing of livestock, chiefly sheep.

One of the included soils is associated with Olcott fine sandy loam in the extensive areas west of Dixon Ridge. The soil here has a 12- to 20-inch layer of gray heavy clay overlying brownish-gray clay which, at a depth ranging from 30 to 50 inches, grades into light grayish-brown sandy clay. The lower part of the subsoil, or substratum, is moderately calcareous but otherwise approaches the character of material underlying the Olcott soil. These bodies, occupying the shallow drainage troughs of this section, are subject to poor and impeded drainage. A few small plantings of deciduous fruits, mainly pears, have been set out, but their unsatisfactory growth evidences the unsuitability of the soil for orchard trees. About half the acreage is devoted to grain, fair yields being obtained in favorable years, and the rest of the land is used for grazing.

Another variation, small areas of which are east of Tremont and south of Binghamton, represents a remnant, caused by erosion of Solano fine sandy loam, from which the upper fine sandy loam layer has been stripped. The soil here consists of dull-gray or dull brownish-gray heavy clay which grades, at a depth ranging from 18 to 30 inches, into light brownish-gray or slightly yellowish gray sandy clay containing disseminated lime and soft calcareous concretions. As they occur at the lower ends of small local streamways, these bodies receive rather large amounts of water and are characterized by notably poor drainage. They are also slightly affected with alkali. For these reasons they are used chiefly for grazing, although small acreages are planted to grain.

The third variation occurs in small enclosed depressions in the east-central part of the piedmont plain. The soil here more closely approaches in character typical Clear Lake clay adobe, but it is differentiated, owing to its more poorly developed drainage and its ponded or lacustrine position. This soil consists of a 12- to 24-inch layer of dull-gray heavy clay overlying darker and slightly compact heavier clay which grades, at a depth ranging from 3 to 4 feet, into light brownish-gray calcareous clay. Areas of this included soil are primarily used for grazing, although in a few more favored spots small acreages occasionally are planted to grain.

Sacramento clay loam.—The surface soil of Sacramento clay loam consists typically of friable dull dark-gray clay loam from 12 to 24 inches thick. This material grades almost imperceptibly into very slightly compact dull-gray silty clay. Both surface soil and subsoil have a high content of organic matter and are mottled with light gray, yellow, rust brown, and drab. The subsoil is generally noncalcareous and in places contains thin lenses or strata of dark-gray or black mucky organic matter. Throughout most of this soil, the water table lies at a depth ranging from 4 to 5 feet below the surface during even the drier months, and for this reason the soil is poorly adapted to deep-rooting plants, but the high organic content and looseness of the soil make it excellently adapted for the production of asparagus and other intensively grown crops.

This soil, as mapped, includes several inextensive areas of nontypical materials. In the southern part of the Yolo By-Pass, a body comprising about 40 acres is characterized by an unusually high content of organic matter. This body is an extension into the Dixon area of a large body of Egbert loam which is mapped in the Suisun area on the south. Near the central part of Merritt Island is an area of about 100 acres characterized by a highly organic subsoil consisting of stratified muck, peat, and mineral sediments. In the south-central and north-central parts of Merritt Island and in the east-central part of Lisbon Island small areas have a highly calcareous subsoil. The soil of some areas is of heavier texture than typical or has in recent years been modified by alluvial deposition of lighter textured materials. Areas of such soil join with Sacramento heavy clay of the Woodland area.

With the exception of the calcareous bodies, which are planted chiefly to sugar beets, the nontypical areas are utilized in the same way as the typical soil.

Sacramento clay loam is the most extensive soil in the river-basin and island division, where it occurs on the almost flat land lying below the higher stream ridges and above the lowest parts of the basin. Areas of this soil in the Yolo By-Pass are inundated periodically, and utilization of the land is largely restricted to the summer grazing of sheep and beef cattle. East of the By-Pass levee, where the land is protected from inundations and where the water table is maintained at a more or less constant depth by an elaborate drainage system, most of the land is under cultivation. Asparagus is grown on about one-third of this eastern acreage, and the yields are good, annually averaging about 2 tons of marketable spears to the acre. The rest of the land is used in the production of sugar beets, which yield about 18 tons an acre, and to the growing of beans, milo, onions, and similar crops.

Sacramento clay loam, friable-subsoil phase.—The friable-subsoil phase of Sacramento clay loam consists of a 15- to 30-inch layer of dark-gray material of variable texture overlying slightly compact dull-gray silty clay loam or clay loam, which grades, at a depth ranging from 30 to 40 inches, into dull brownish-gray or light brownish-gray loose lighter textured material slightly mottled with yellow and rust brown. The subsoil and the surface soil in many places are definitely calcareous, the lime being disseminated uniformly throughout the soil mass. Soil of this phase is extensive on and adjacent to Merritt and Lisbon Islands, where it occupies the intermediate slopes of stream ridges along Babel and Elkhorn Sloughs and along Sacramento River. Owing to the increased slope and slightly higher elevation, these places have better drainage and the water table normally lies at a depth of 6 feet or deeper.

Much of the more elevated and better drained areas is occupied by orchards of pears and other deciduous fruits. The pear acreage has been reduced somewhat in recent years, owing to the susceptibility of the trees to blight. Vegetable seed, beans, onions, and truck crops are grown on the sites of the former pear orchards. In the northern part of the area, especially on Lisbon Island, soil of this phase has long been utilized in the production of high-grade alfalfa hay, and more recently considerable acreages have been planted to

sugar beets. Both crops have made satisfactory growth on even the more calcareous bodies.

Sacramento clay.—To a depth ranging from 12 to 20 inches, Sacramento clay consists of comparatively friable dull-gray clay which is underlain by slightly compact and darker dull-gray clay. The surface soil and upper part of the subsoil have a high content of organic matter and are mottled with rust brown, yellow, and light gray. With a water table normally lying at a depth ranging from 3 to 4 feet, the lower part of the subsoil is only slightly mottled and in many places is lighter gray. Although in a few places lenses and thin strata of dark-colored organic material are present, the subsoil in most places is markedly calcareous, the lime occurring both in disseminated form and as soft nodular accumulations.

Under natural conditions this is the most poorly drained soil in the Dixon area. Occurring in the lowest part of the Yolo Basin, it formerly received the excess waters of Putah Creek and other local streams, as well as the overflow from Sacramento River. Periodically it was covered by shallow and comparatively open bodies of water, which were soon overgrown by tules and other water-loving plants, but at present all but a very small part of the land is protected by levees, and drainage is markedly improved. The reclaimed part is well adapted to the production of sugar beets, and the more highly organic and less calcareous areas are suitable for asparagus and other intensive crops.

Sacramento clay occurs in two areas, the larger of which is about 20 square miles in extent. With the exception of the unreclaimed part, which lies within the Yolo By-Pass, most of this soil is under cultivation. More than half of the larger area is utilized in growing sugar beets, and the rest is devoted about equally to asparagus, beans, milo, and onions. An eastern lobe of this area, the bed of former Lake Winchester, has an unusually high content of organic matter and is mainly used in the production of tomatoes and other truck crops. The smaller area of this soil, lying about 2 miles northwest of Clarksburg, is also reclaimed and under cultivation. It, likewise, is the bed of a former lake and has a higher organic-matter content than typical. It is planted almost exclusively to truck crops.

Columbia silty clay loam.—The surface soil of Columbia silty clay loam ranges from 10 to 50 inches in thickness. It consists of light-brown, light grayish-brown, or pale yellowish-brown silty clay loam and rests on gray or dull brownish-gray loose material of similar or lighter texture. This soil represents a comparatively recent overwash of Sacramento River alluvium, the thickness of which diminishes with distance from the stream, resting on the friable-subsoil phase of Sacramento clay loam. The overwash material has a low content of organic matter and a moderate water-holding capacity, but it is friable and permeable, offering few difficulties to cultural operations, and is ordinarily well adapted to a wide variety of crops. The lower part of the surface layer is mottled with rust brown, yellow, and gray, and in some places it is very slightly calcareous. Most of the lower grayer material is moderately calcareous and in other features approaches the character of adjacent bodies of Sacramento soil.

Columbia silty clay loam is not extensive, and it occurs only in the reclaimed part of the river-basin and island division. The largest area, about 1,000 acres in extent, lies along Sacramento River near Riverview, and a number of very much smaller areas lie along the elevated banks of Babel and Elkhorn Sloughs and along the river. Most of the northern bodies are used mainly in the production of alfalfa, although parts of them, as well as most of the southern areas, are occupied by pear orchards. As on Sacramento clay loam, friable-subsoil phase, many of the pear trees have been removed, owing to blight. Some of the former orchard land is planted to vegetable seed crops, to which the soil is well suited.

Denverton and Hartley soils, undifferentiated.—The Denverton and Hartley soils, undifferentiated, comprise a large number of bodies of intricately mixed soils in the eastern lower part of the English Hills. This mixture of soils is apparently a result of erosion and creep of soil materials derived from softly consolidated and different strata. Many of the component soils in these areas are typical soils which are mapped in other parts of the Dixon area, but which in these bodies are not of sufficient individual extent to be differentiated. Hartley fine sandy loam, Denverton clay adobe, and gradations between these two soils predominate, although in some of the western areas the characteristics of the Hugo or Los Osos soils are approached. In general, it appears that much of the former land surface in this part of the English Hills was occupied by soils similar to the Hartley soils which rested at a comparatively slight depth on the calcareous sediments from which the Denverton soils are derived. With continued dissection and removal of the original surface material, which resulted in the present relief, many of the low hills and narrow ridges retained a capping of Hartley fine sandy loam, and the deeper strata, where exposed by erosion, weathered into Denverton clay adobe. Many gradations between these two soils were developed in intermediate situations. Variations in the character of the exposed strata and in the rate at which the surface material was removed or deposited also resulted in marked differences between the soils.

As regards their suitability for agriculture the soils of this undifferentiated group are equally varied. In general, most of the areas are utilized for the production of grain and for grazing. Many, in which the surface soil is of light or medium texture, particularly where the subsoil is not too compact and impervious, have been planted to orchards and vineyards. These have been fairly successful, largely owing to the climatic conditions prevailing in this somewhat elevated district.

Los Osos and Hugo soils, undifferentiated, steep phase.—Los Osos and Hugo soils, undifferentiated, steep phase, comprise the more rugged parts of the eastern slope of Vaca Mountains, which, owing to their rough and mountainous relief and their isolation, cannot profitably be brought into cultivation at present. This extensive area of undifferentiated material is more or less brushy and forested, and the soil covering is thin, as a result of severe erosion. A few of the more open and less steeply sloping areas furnish some grazing. Had it been practical to search out and differentiate these areas, they might have been mapped as individual steep phases of the Los Osos

and Hugo soils, to which the soil covering of this general district bears a close resemblance. With the exception of a small amount of grazing in some places, the land is of little value other than as a producer of firewood and fence posts.

River wash.—River wash comprises the comparatively barren areas of sand, gravel, and boulders occupying the flood-swept land along the Putah Creek Channel. A number of very narrow bodies of this material are distributed from the mouth of the gorge of this creek, at the base of Vaca Mountains, to a point on the South Fork just north of Tremont. In general, this land is barren of vegetation, although in places it supports a scattered growth of cottonwoods, willows, and brush. It is of no agricultural value.

SOILS AND THEIR INTERPRETATION

The Dixon area is characterized by a Mediterranean type of climate. Russell, in his application of Koeppen's classification to California, places the central and northeastern parts in the "Hot Summer Mediterranean" and the remainder in the "Cool Summer Mediterranean" (*5*). Moreover, small yet definite variations in both rainfall and temperature occur within the limits of the area. In the mountain-and-valley division in the western part the annual precipitation is approximately 25 inches, or about 10 inches greater than that in the central and eastern divisions, and the temperatures also are somewhat higher. These climatic differences are reflected in the soil profiles to only a slight degree, which is partly explained by the fact that all the more extensive soils are in "recent" or "semimature" stages of development (*6*, *7*).

Associated with these climatic influences, and likewise reflected to some extent in the soil profile, is the factor of drainage. In general, the western part of the area is well drained, despite the higher rainfall, whereas the eastern part, especially the extensive body of nearly flat basin land, is characterized by poor drainage and is subject to inundation during periods of heavy stream run-off. These inundations, caused by a concentration in the basin of waters that have passed over the surface of the valley plain, also account for the finer sediments from which are formed the heavy-textured slowly permeable soils of this lowland district. A large part of the basin remains wet throughout the year, even during the hot dry summer period, and this to some extent tends to offset the influence of the lower rainfall on soil development.

The soils are predominantly brown, with rich brown or reddish brown prevailing in the western part of the area where precipitation is greater, and dark dull brown or grayish brown in the central and eastern parts. The poorly drained soils of the basin, which support a rank vegetal cover, have a comparatively high content of organic matter and are dull gray or dark gray. As a further reflection of the influence of drainage and climate, the soils of somewhat less organic content, bordering the basin, and also those occupying the shallow drainage depressions in the valley plain have calcareous subsoils. In these soils, the lime appears to be the product of weathering processes, the rate of its accumulation being partly influenced by the amount of infiltration from other, higher lying land. In contrast, some of the primary soils in

the English Hills have calcareous subsoils, in which part if not all of the lime apparently is inherited in a nodular or fragmental form from the parent material.

Physiographic processes, rather than climatic or drainage conditions, have been mainly responsible for the major differences in the soil profiles. For a long time, aggradation has been active. Erosion is incising and stripping the surface from the primary soils on the higher slopes and elevations, and transient stream courses are depositing new alluvium over the secondary soils of valley and plain. In recent years, alluviation has been checked in some parts of the area, for example, by the erection of artificial barriers in the basin and island division along Sacramento River. Even in these places, however, insufficient time has elapsed to produce recognizable changes in profile, and the soils continue to exhibit the features developed during an extended period of more or less constant additions of surface material.

Through either the removal or the addition of surface material, both erosion and alluviation tend to rejuvenate the soil and prevent the development of mature profile characteristics. Sheet or rill erosion, as it occurs in the hills and mountains to the west, is accompanied by a gradual lowering of the surface level and a consequent downward migration of the soil horizons. With a rather close vegetal cover, such erosion proceeds slowly and with some degree of uniformity; between it and the other soil-forming processes, a condition of dynamic equilibrium is essentially maintained. Tersely, it might be said that today's eluviated (A) horizon was yesterday's illuviated (B) horizon. The resulting "climax soil", under these specific conditions, is characterized by comparatively thin and imperfectly developed horizons and is not a truly mature soil, in the commonly accepted sense of that term.

In contrast to erosion, alluviation is accompanied by a raising of the surface level and a consequent upward migration of the soil horizons. This process occurs throughout most of the valleys and lowlands of the area, but differs somewhat in its intensity, depending on local conditions. With the exception of certain localities, such as that along Putah Creek, where the alluvial mantle is being deposited too rapidly for a simultaneous maintenance of profile characteristics, alluviation is in some degree at an equilibrium with the processes of soil formation. Each increment of surface material tends to raise the upper limit of the zone of illuviation; thus, it might be said, that today's illuviated (B) horizon was yesterday's eluviated (A) horizon. As in the case of the erosional factor, this continual alluviation tends to result in climax soils having immature profiles. In contrast, however, these soils have comparatively thick horizons and commonly reflect to a greater degree the mineralogical characteristics of the parent material.

On the basis of their profile characteristics, the 13 series of soils mapped in the Dixon area are placed in 4 general groups as follows:

(1) Immature primary soils developed under conditions of contemporary erosion. This group comprises the brown soils of the Vaca Mountains and the English Hills, derived from consolidated or partly consolidated sedimentary rocks. These soils are characterized by comparatively shallow immature profiles and are subject to

erosion. The group includes the soils of the Los Osos, Hugo, and Denverton series.

(2) Immature secondary soils developed under good or fair drainage and contemporary alluviation. This group comprises the brown soils of the piedmont-plain division and some of the mountain valleys to the west, developed on unconsolidated comparatively recent alluvial deposits, which have recent semimature profiles, depending on the rapidity of contemporary alluviation. This group includes the soils of the Yolo, Zamora, Esparto, and Capay series.

(3) Secondary soils with solonetzlike profiles and not subject to contemporary alluviation. This group comprises the grayish-brown or reddish-brown soils occurring chiefly in the western part of the piedmont-plain division, formed from old (and possibly saline) alluvial deposits. The soils of this group have comparatively mature and distinctive profiles, the friable sandy loam of the eluviated horizon abruptly changing to the tight columnar solonetz clay of the illuviated horizon. Included in this group are the soils of the Olcott, Hartley, and Solano series.

(4) Immature secondary soils developed under poor drainage and contemporary alluviation. This group comprises the grayish-brown or dark-gray soils developed under basinlike conditions of restricted or ponded drainage, and they have moderate or high contents of organic matter. These soils occupy the whole basin-and-island division, as well as most of the shallow drainage troughs in other parts of the area. The group includes the soils of the Columbia, Sacramento, and Clear Lake series.

Detailed descriptions of one or more representative profiles of soils of each of the four general groups are presented in the following pages:

A profile of Los Osos clay loam, as observed in the southern part of the English Hills 3 miles north of Vacaville on the Browns Valley road, is representative of the soils in the first group. Under virgin conditions this soil area supports a parklike vegetal cover of native grasses and annual plants, together with scattered trees and bushes. The 2-inch surface layer consists of dull grayish-brown sandy clay loam or heavy loam, of granular structure, containing many grass roots and small root channels. The horizon of eluviation, which extends to a depth of 10 inches, is brown or dark-brown sandy clay loam of rather firm consistence, but crumbling under slight pressure into medium and coarse granules. The transition from this horizon to the underlying illuviated horizon is marked by a barely perceptible change in color and structure. The horizon of illuviation consists of heavy sandy clay loam or clay loam of somewhat darker color and greater compaction, which breaks readily into medium or coarse clods and, with increased pressure, into granules. With increasing depth the material in this horizon becomes lighter in color, coarser, and less compact, and at a depth of about 24 inches it is brown or light-brown sandy clay loam or loam, containing many partly weathered fragments of the sandstone from which the soil is derived. No part of the profile shows evidence of lime, although the underlying unweathered sandstone in this locality effervesces freely with dilute hydrochloric acid.

A, Farmstead in the island district, representative of the better class of farm homes located on the better drained soils adjacent to Sacramento River. *B*, Mounds on Solano fine sandy loam.

The profile of the Hugo soils is similar to the one described, the principal difference being one of color, probably owing to differences in the character of the parent materials. The eluviated horizon of Hugo clay loam is grayish brown, and the illuviated horizon is slightly lighter grayish brown with a somewhat yellowish-brown shade when moist.

The area of Denverton clay adobe lying about 5 miles north of Vacaville, in the eastern part of the English Hills, exhibits a profile representative of those soils in the first group which have been developed in place on partly consolidated calcareous sediments. Under virgin conditions this area supports a comparatively close cover of native grasses and annuals, which make a vigorous growth in late winter and spring and wither during the hot dry days of midsummer. The 2-inch surface layer consists of dark-brown clay with a granular structure. Below this and continuing to a depth of about 12 inches, is dark-brown or dark rich-brown clay containing many fine grass roots in its upper part and a few widely scattered small particles of calcareous material in the lower part. The material in this horizon is plastic and massive when wet but shrinks on drying into the hard blocks and angular fragments typical of an adobe soil. The transition to the underlying horizon is gradual, as in Los Osos clay loam, and is evidenced chiefly by a lighter color and a slight change in structure. This, the illuviated horizon, extends to a depth of slightly more than 2 feet and consists of brown or light grayish-brown compact sandy clay having a poorly developed cubical or cloddy structure. Throughout this horizon, especially in the lower part, are numerous light-gray stains and nodules which effervesce vigorously with dilute acid. Apparently these have originated in the parent material, although there is some indication of partial redistribution and concentration of the lime. The parent material, into which this horizon merges, is light grayish-brown or light yellowish-brown massive and partly consolidated sandy clay loam which is calcareous to an undetermined depth and is characterized by intermittent seams and nodules of lime.

The soils included in the second group have profiles ranging in degree of development from alluvial deposits to moderately mature soils, depending on the age and rate of alluviation. The first condition is represented by a body of Yolo fine sandy loam along the south bank of Putah Creek about 3 miles southeast of Davis. This recent soil, which is little more than a deep deposit of assorted and stratified alluvial stream-laid materials, has a virgin cover of trees and brush, with here and there an open space supporting a comparatively rank growth of native grasses and annuals. The soil is in an initial stage of development. The surface soil, to a depth of about 15 inches, is brown or grayish-brown loose fine sandy loam, and the subsoil, being less subject to recent organic staining, is light-brown or light grayish-brown fine sandy loam having similar structure and consistence.

Yolo silty clay loam, however, as occurring in this survey, represents an incipient stage in development. A typical body occurs on Dixon Ridge about 2 miles west of Dixon. In virgin areas the topmost inch or two of material is dull-brown or dull grayish-brown

silty clay loam having a small-granular or platy structure and containing numerous grass roots and plant remains. The horizon of eluviation, which extends to a depth of about 15 inches, consists of brown or dull-brown silty clay loam of somewhat firm consistence, but which readily breaks into small clods and medium-sized granules. This horizon grades into an underlying illuviated horizon of slightly denser heavy silty clay loam having a distinctive structure and coloring. The horizon of illuviation, which extends to a depth of about 3 feet, is composed of small angular aggregates or fragments, the interiors of which are brown or light yellowish brown. The exteriors of the aggregates, also the walls of root holes and other channels, are thinly coated with a dark grayish-brown deposit which superficially gives this horizon a darker color than the horizon above. When thoroughly pulverized, however, the granules are of approximately the same color as the underlying parent material which is loose and permeable brown or light yellowish-brown silt loam or silty clay loam.

In the survey of the Sacramento Valley, in which mapping was conducted with little detailed study of soil profiles, the Zamora soils, which were later established as belonging to a distinct series, were mainly included with the associated Capay and Yolo soils. The Zamora soils are of more mature development than the Yolo soils, are better drained, and lack the lime accumulation of the Capay soils.

The profile of Zamora silty clay loam 1½ miles northwest of Elmira is typical of a moderately mature soil of group 2. Under virgin conditions this soil supports a grassland cover and an occasional oak tree. The 2-inch surface layer is dull-brown or dull dark grayish-brown silty clay loam of granular or somewhat platy structure, containing numerous grass roots and plant remains. Below this and continuing to a depth of about 14 inches is loose and slightly granular brown or dull dark-brown material of similar texture, which grades into an underlying horizon of comparatively dense clay loam. Toward the upper part of this illuviated horizon the material has an incipient prismatic structure, but in the lower part it is characterized by small or medium-sized clods. With gentle pressure the clods break into small angular granules, the interiors of which are brown or light brown. As in Yolo silty clay loam, but to a more advanced degree, the jointing planes and the walls of channels in this horizon are coated with a dark grayish-brown deposit, accompanied in the upper part by dark staining of the granules, which penetrates to a depth of one-sixteenth inch or less. At a depth ranging from 3 to 4 feet below the surface, the illuviated horizon grades into the parent material which consists of brown or light yellowish-brown clay loam of massive structure, but more friable than the material above, and, in some places, it is very slightly mottled with reddish-brown stains. As occurring in the Dixon area, the soils of this series have a minor range in color. In the west, where an important part of the alluvial material originates among the reddish-brown primary soils of the English Hills, the soils are richer brown or more reddish brown than typical, but the eastern areas, marked by a slighter gradient and slower drainage, are duller brown or more grayish brown.

The Esparto soils, which occur along the margins of Vaca and Pleasants Valleys, in general represent soils developed on outwash materials from adjacent bodies of Hugo soils. In profile they are similar to the Zamora soils. The distinguishing difference is the light grayish-brown color which prevails throughout the solum. The color of the underlying parent material is, moreover, light brown with a mottling of reddish-brown and yellowish-brown stains.

The Capay soils have approximately the same structural character as the Zamora soils, and they represent about the same degree of profile development. Occurring in interridge areas having a more nearly flat relief, they have developed under a slower rate of alluviation and poorer drainage than the Zamora soils, and most of the soil particles are smaller. In color the Capay soils are grayer than the Zamora soils, being dark dull brown or dark grayish brown in the horizon of eluviation and dark grayish brown in the illuviated horizon. The underlying parent materials of the soils of the two series are similar, with a single exception—the Capay soils are characterized by the presence of lime in the lower part of the illuviated horizon and also in the parent material. In most places the lime is in disseminated form in the lighter textured members of the series although nodular accumulations and concretions may also be present in the heavier soils. For like reasons, as in the Zamora soils, the western bodies of the Capay soils are richer brown or more reddish brown, whereas the eastern bodies are a duller, more gray, shade of brown.

In mapping the Sacramento Valley some of the soil areas included with the Solano and Yolo soils of that survey are now, owing to more detailed study of soil profiles and more accurate delineation of soil boundaries, recognized as conforming better to soils of the Capay series.

The profile of Olcott fine sandy loam, as observed in a typical body lying 3 miles north of Elmira, provides a good example of one of the solonetzlike soils included in group 3. Under virgin conditions this soil supports a grassland cover. The 2-inch surface layer consists of brown or light grayish-brown fine sandy loam having a granular or slightly platy structure. Below this and extending to a depth of about 20 inches, is light-brown or light grayish-brown fine sandy loam which with very slight pressure breaks into small granules and single-grained particles. Numerous grass roots are present in this horizon, especially in its upper part, with most of the many root holes and cavities coated with a dark organic stain. In the lower part of the horizon, the walls of the cavities have a barely perceptible gray color becoming more pronounced with depth. The lowest layer in this horizon of eluviation consists of ash-gray or light brownish-gray fine sandy loam ranging in thickness from about one-half inch to as much as 2 inches. The upper part of this layer is softly laminated and readily breaks into small granules and single grains, and the lower part is firmer and somewhat platy but can be crushed into coarse angular granules. This gray layer grades abruptly into an underlying illuviated horizon consisting of brown or rich-brown comparatively dense clay. On drying, the clay assumes a distinctly columnar structure, with the tops of the columns having the lighter gray color and slight convexity. The columns are roughly hexagonal with definitely angled edges, have a horizontal

dimension ranging from 2 to 5 inches, and are from 6 to 8 inches in length. The faces of the columns and also the walls of infrequent root holes and other channels have a coating of dull-brown or dark-brown colloidal material. In the upper part of the horizon, this coating is obscured to some degree by a downward migration of particles from the ash-gray layer surmounting the columns. With increased depth, a fairly regular arrangement of angular lumps and fine clods is developed. At a depth ranging from 3 to 4 feet, a rather massive and dense substratum is present, which consists of light yellowish-brown loam or clay loam, mottled with dark-brown and rust-brown staining and containing a few widely scattered minute iron pellets. The entire solum is noncalcareous.

The Olcott soils were first recognized in the survey of the Suisun area as representing a distinct series of soils, and in the early reconnaissance mapping were included with the associated soils of the Capay and Solano series.

The soils of the Hartley series are similar in structural development to those of the Olcott series, but they are developed on somewhat different parent materials, are characterized by a light reddish-brown or light brownish-red color, and contain numerous quartzitic pebbles and cobbles. They were, together with the Denverton soils with which they are associated in this area, included in variations of the Montezuma soils of the early reconnaissance survey and have only in the Dixon area been recognized as representing a distinct soil series.

An area of Hartley fine sandy loam, located one-half mile south of Wolfskill at the eastern base of the English Hills, shows a representative profile of these soils as developed in this district of slightly higher rainfall and greater surface gradient. The eluviated horizon, extending to a depth of 21 inches, consists of light brownish-red fine sandy loam having a fine-granular structure. The material in the lower inch or two of this horizon is of duller, or more gray, color, but not ash gray as developed in the Olcott soils. This material changes abruptly to the columnar illuviated horizon of red or brownish-red tight clay which gradually becomes browner and slightly more yellow with depth. The substratum, which lies at a depth of about 3 feet, is comparatively dense and massive but somewhat less tough, and it consists of light-brown or dull-red clay having a somewhat yellow or pink tint. As in the Olcott soils, the entire solum is noncalcareous.

Solano fine sandy loam is representative of the solonetzlike soils of group 3, which are characterized by calcareous subsoils. A typical body of this soil lies about 2 miles south of Binghamton, and other equally typical and more extensive areas occur a few miles farther south, in the Suisun area (*1*). In marked contrast to Hartley fine sandy loam, Solano fine sandy loam occurs on comparatively flat relief and has been developed under conditions of poorer drainage and salt accumulation. Under virgin conditions it supports a grassland cover dominated by saltgrass (*Distichlis spicata*), and its surface is marked by numerous local areas of saline efflorescence. Throughout the greater part of its occurrence in the Dixon area, this soil has a hummocky surface configuration. The hummocks rise to an elevation ranging from 20 to 30 inches, range from 10 to 20 feet in diameter, and appear to be residual remnants resulting from sheet

or surface erosion. The upper inch of the soil profile is brownish-gray or yellowish-gray friable and deflocculated fine sandy loam. The material in this layer is acid in reaction, and small spots on the northern slopes of the hummocks have a cover of moss in addition to the saltgrass. Below this and continuing to a depth ranging from 12 to 20 inches, is light brownish-gray, yellowish-gray, or pale-yellow fine sandy loam which crumbles very readily into small granules and single grains. The extreme lower part of this eluviated horizon consists of a layer of ash-gray fine sandy loam approximately 2 inches thick. The upper part is very slightly laminated, the lower part is firmer and somewhat platy, and the material in both parts can be readily crushed into small angular granules. The abruptly underlying illuviated horizon extends to a depth of about 3 feet. It consists of dull grayish-brown comparatively dense clay having a distinctly columnar structure when dry. The columns, which are roughly hexagonal and have well-rounded tops, range from 6 to 8 inches in length and from 2 to 4 inches in diameter. With increasing depth, a comparatively regular arrangement of angular lumps and clods develops, the color approaches light brownish yellow, and a few small particles of lime are in evidence. The illuviated horizon grades into light brownish-gray or light-yellow sandy clay or clay loam, having a massive and slightly compact structure. This substratum is definitely calcareous and contains numerous lenses and nodules of lime carbonate.

In the fourth group, the Clear Lake soils occur in the shallow drainage depressions and along the eastern edge of the piedmont-plain division, the Sacramento soils occupy all the lower lands of the basin-and-island division, and the Columbia soils are the lighter colored soils of lower organic content, which border the river and streamways of the last-named division.

The Clear Lake series of soils has been established in one of the more recently surveyed areas, but soil conforming to this in character recognized in this area as Clear Lake clay adobe, was, in the inclusive reconnaissance mapping of the Sacramento Valley area of 1913, included with associated low-lying soils of the Capay, Sacramento, and Solano series. Of these three, it more closely resembles the darker and heavier textured members of the Capay and Sacramento series, but it bears little relation to the Solano soils.

A representative body of Clear Lake clay adobe lies about 6 miles east of Binghamton. Under virgin conditions, this soil supports a dense cover of native grasses and annuals, with the wet-land species predominating. The 1-inch surface layer of a profile examined consists of dark-gray or dark brownish-gray somewhat silty clay which is more or less suggestive of a thin recent-alluvial deposit. Several other areas of this soil, particularly those in the northern part of the area where Putah Creek debouches on the valley plain, have distinct surface deposits of recent alluvium of a maximum thickness of 5 inches. This surface layer has an angular fine-granular structure and contains appreciable quantities of undecomposed plant remains. Below this layer and extending to a depth of about 15 inches is dark-gray or black heavy clay which is plastic and without pronounced structure when wet. On drying, however, the material develops a typical adobe structure and is characterized by large prismatic columns which gradually break down into hard

angular fragments as desiccation continues. This horizon grades into an underlying horizon of similar color and texture, which has a definitely cloddy structure and contains small accumulations of lime in the lower part. At a depth of 30 inches this horizon, in turn, grades into a horizon having fewer distinct concentrations of lime, but which is uniformly calcareous. An underlying substratum of light yellowish-gray clay occurs at a depth of 54 or more inches below the surface. This material is dense and amorphous in structure, and the lime is concentrated in zones and seams as very light-gray granular material.

The soils of the Sacramento series have developed under conditions favorable to the accumulation of organic matter, the greater part of which is well decomposed, although in a few places in the subsoil a stratum of fibrous material may occur. Under virgin conditions these soils occupy low flat areas subject in the past to periodic overflow, and they support a dense growth of tules and sedges, the roots and fragmental remains of which are conspicuously present in the upper part of the solum.

An area of Sacramento clay lying in the central part of the Holland tract, about 4 miles southwest of Clarksburg, shows the typical profile of these soils. Where undisturbed, the topmost inch of soil consists of gray or light brownish-gray granular silty clay loam representing a comparatively recent deposit of alluvium mixed with plant remains in various stages of decomposition. Under cultivation, the identity of this layer is lost. Below this and extending to a depth of about 12 inches is dull-gray or dull brownish-gray clay which is loose in consistence, granular in structure, and has a high content of organic matter. Many living roots, as well as decayed organic material, are present in this horizon which is spotted and stained to some extent with a variety of colors. The well-decomposed plant remains are dark gray or sooty black, the walls of recently occupied root channels are rust brown or yellowish brown, and the fragments of surface alluvium which have worked their way downward occur as light-colored lumps and spots. In some places this variegation of the basic dull-gray horizon is further emphasized by the presence of light brownish-red particles that probably have had their origin in summer fires which occasionally swept through the vegetal cover. This horizon grades into an underlying horizon of similar or slightly lighter color and lower organic content. It is somewhat more compact than the horizon above and, on drying, checks into a faintly developed cubical or prismatic structure. Its upper part is marked to somewhat less extent by the varicolored spots already described, and its lower part shows the rust-brown and yellowish-gray mottlings developed by restricted drainage. At a depth of about 4 feet (approximately the plane of the permanent water table) a lower subsoil horizon is present. This consists of plastic and massive dull-gray or slightly bluish gray silty clay or clay, which contains disseminated lime. A few calcareous concretions and crystals of gypsum may also occur.

The soils of the Columbia series, as mapped in the area, are essentially a deep deposit of comparatively recent Sacramento River alluvium on a subsoil material comparable to a light-textured soil of the Sacramento series. The area of Columbia silty clay loam at

Riverview on the west bank of Sacramento River has a surface layer of light-brown or light grayish-brown friable softly pulverulent silty clay loam. The lower part of this deposit is distinctly mottled with gray and rust-brown stains, indicative of impeded drainage. At a depth of about 36 inches the surface layer abruptly grades into brownish-gray loose material of similar or somewhat variable texture, which is darkest in its upper part, becoming lighter in color with depth. The dull color of this layer is emphasized slightly by a yellowish-brown or rust-brown coating on the walls of abandoned root holes and on the faces of the few fissurelike crevices.

In figure 3 are shown diagrams of the profiles of five representative soils in the Dixon area.

LABORATORY STUDIES OF SOILS FROM THE DIXON AREA [4]

Samples representative of most of the soil types recognized during the survey of the Dixon area have been studied in the laboratories of the division of soil technology, University of California, where moisture-equivalent determinations, mechanical analyses, hydrogen-ion concentration, and other determinations have been made. The results of these are given in table 4.

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[4] This discussion has been prepared by C. F. Shaw, head, division of soil technology, University of California.

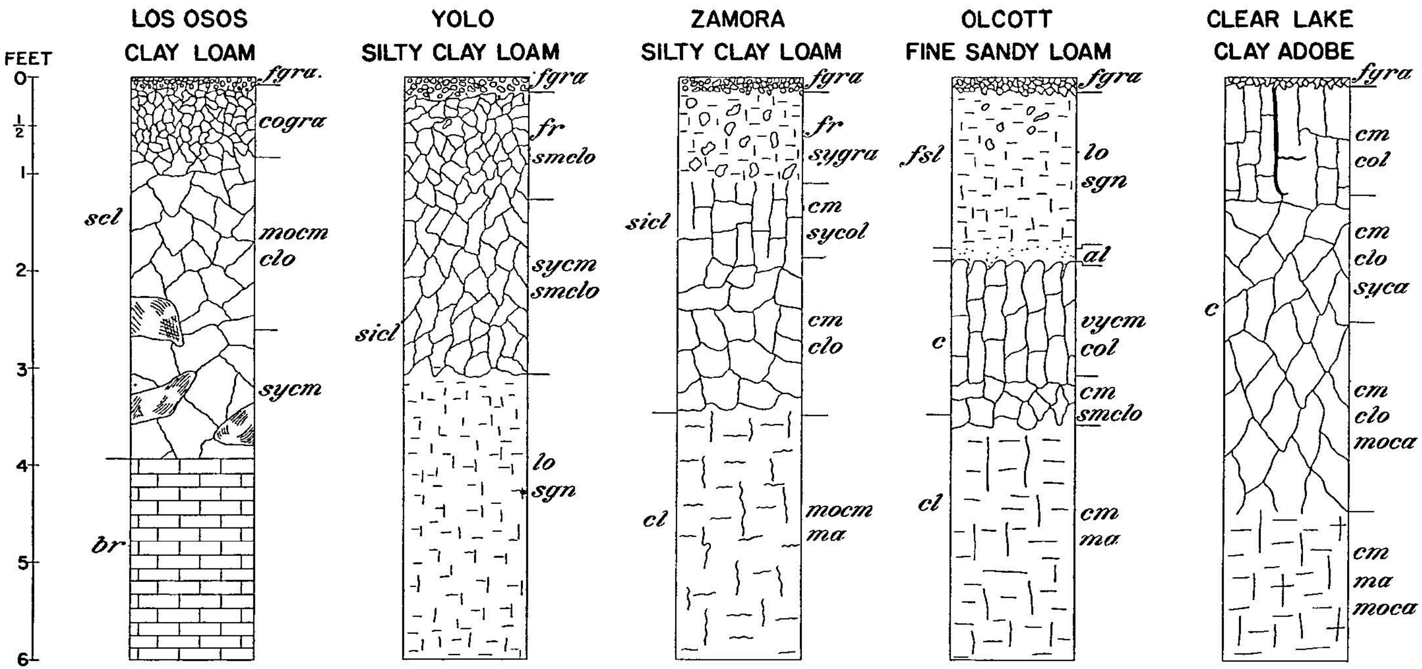

FIGURE 3.—Diagrams of profiles of representative soils in the Dixon area, Calif.

LEGEND

(Texture)		(Structure, etc.)					
fsl	Fine sandy loam	*sycm*	Slightly compact	*fr*	Friable	*sycol*	Slightly columnar
scl	Sandy clay loam	*mocm*	Moderately compact	*smclo*	Small cloddy	*col*	Columnar
cl	Clay loam	*cm*	Compact	*clo*	Cloddy	*lo*	Loose
sicl	Silty clay loam	*vycm*	Very compact	*sygra*	Slightly granular	*al*	Ashy layer
c	Clay	*syca*	Slightly calcareous	*fgra*	Fine granular	*ma*	Massive
br	Bedrock	*moca*	Moderately calcareous	*cogra*	Coarse granular	*sgn*	Single grain

TABLE 4.—*Mechanical analyses of soil samples from the Dixon area, Calif.*[1]

Soil type and sample no.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay [2]	Colloid [3]	Total clay	Moisture equivalent (average)	pH
Hugo fine sandy loam:	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
577982	0–10	0.52	4.36	7.98	26.69	19.20	22.46	5.34	13.45	18.79	16.3	6.8
577983	10–26	.43	2.65	9.12	28.46	18.15	18.89	5.04	17.26	22.30	18.7	6.2
577984	26–36	.33	6.12	11.55	40.90	14.56	17.68	4.17	4.69	8.86	17.8	6.1
Hugo clay loam:												
577960	0–10	.20	.50	.31	2.16	5.41	41.41	13.84	36.17	50.01	27.7	6.5
577961	10–26	.09	.16	.23	1.33	4.02	33.87	15.69	44.61	60.30	26.5	6.6
577962	26–36	.12	.11	.23	.92	3.89	42.55	14.40	37.78	52.18	26.2	6.7
Los Osos clay loam:												
577966	0–10	.16	3.86	6.84	24.31	14.41	16.94	7.48	26.00	33.48	24.1	6.1
577967	10–24	.42	1.81	11.14	24.85	12.85	15.23	6.15	27.55	33.70	24.7	6.2
577968	24–42	.38	3.14	14.82	27.92	13.84	13.40	4.40	22.10	26.50	22.5	6.4
Denverton clay adobe:												
577969	0–12	.51	1.46	1.34	5.82	5.74	24.53	11.35	49.25	60.60	32.0	7.4
577970	12–30	.06	.23	10.75	6.84	6.44	16.88	10.22	48.58	58.80	29.7	8.5
577971	30–54	1.85	12.74	11.27	28.20	11.16	9.78	3.95	21.05	25.00	17.7	8.4
Yolo silt loam:												
577952	0–15	.06	.19	2.32	9.86	13.65	51.10	8.52	14.30	22.82	23.6	7.2
577953	15–72	.04	.22	1.41	23.04	21.06	32.49	6.59	15.15	21.74	18.8	7.8
Yolo silty clay loam:												
577933	0–15	.67	1.15	2.32	2.36	3.48	43.32	11.19	35.51	46.70	28.6	7.4
577934	15–36	.58	.86	.85	1.14	4.25	43.93	21.80	26.59	48.39	30.4	7.8
577935	36–72	.66	2.54	2.07	4.62	5.12	50.09	14.06	21.84	35.90	28.2	7.9
Zamora silty clay loam:												
577943	0–14	.41	.74	2.42	11.35	14.80	37.93	3.58	28.77	32.35	24.2	6.7
577944	14–42	.18	.59	2.62	10.43	14.80	36.63	9.57	25.18	34.75	24.2	6.5
577945	42–72	.12	.14	.48	3.39	7.09	41.40	11.89	35.49	47.38	52.2	8.1
Zamora clay loam:												
577946	0–14	.09	.17	.32	2.60	5.16	39.36	13.52	38.78	52.30	29.2	7.5
577947	14–45	.08	.08	.41	3.35	5.89	36.01	12.35	41.83	54.18	29.3	7.3
577948	45–72	.01	.15	.44	6.42	8.76	32.64	10.10	41.48	51.58	42.3	8 3
Esparto silty clay loam:												
577963	0–15	.04	.21	1.97	10.21	13.20	40.80	9.69	23.88	33.57	22.1	6.5
577964	15–45	.09	.50	1.58	9.96	11.88	37.95	10.33	27.71	38.04	23.8	6.0
577965	45–72	.09	.15	1.93	8.93	11.19	39.10	15.35	23.26	38.61	24.0	6.3
Capay loam:												
577901	0– 6	.05	.05	.78	4.55	4.36	48.16	18.97	23.18	42.15	31.0	7.7
577902	6–21	.05	.25	.72	7.02	6.56	40.30	17.79	27.31	45.10	27.4	8.0
577903	21–72	.00	.05	.80	7.76	9.43	44.85	16.16	20.95	37.11	47.5	9.1

[1] Analysis by pipette method.
[2] Clay includes particles from 0.005 to 0.002 millimeter in diameter.
[3] Colloid includes particles less than 0.002 millimeter in diameter.

TABLE 4.—*Mechanical analyses of soil samples from the Dixon area, Calif.*—Continued

Soil type and sample no.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay	Colloid	Total clay	Moisture equivalent (average)	pH
Capay silty clay loam:	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
577904	0–12	0.55	0 58	1.65	5.70	7.35	38.55	11.27	34.35	45.62	28.0	7.9
577905	12–42	.00	.25	.88	6.16	7.47	30.34	19.60	35.30	54.90	30.1	7.1
577906	42–72	.28	.69	2.42	11.33	12.53	27.15	6.11	39.49	45.60	40.9	8.6
Capay clay:												
577914	0–12	.09	.04	.22	1.98	4.55	29.92	31.70	31.50	63.20	40.9	7.0
577915	12–38	.04	.02	.18	2.34	4.96	29.96	24.74	37.76	62.50	52.4	8.1
577916	38–72	.02	.03	.20	3.22	6.72	36.01	10.40	43.40	53.80	31.9	7.9
Olcott fine sandy loam:												
577939	0–19	.81	5.52	7.74	25.50	20.52	25.17	5.44	9.30	14.74	13.4	6.6
577940	19–21	1.05	3.39	9.72	26.68	18.06	24.69	4.77	11.64	16.41	14.1	6.7
577941	21–42	.21	1.97	3.11	18.41	16.75	22.07	5.48	32.00	37.48	43.9	6.8
577942	42–72	.20	1.41	2.59	13.90	20.40	27.70	6.31	27.48	33.79	29.4	7.6
Hartley fine sandy loam:												
577956	0–18	1.64	1.75	1.76	5.39	21.68	49.70	7.22	10.86	18.08	16.2	5.9
577957	18–21	1.23	.96	2.11	6.04	21.49	48.85	6.73	12.50	19.23	16.8	6.3
577958	21–36	1.47	1.38	1.58	6.51	10.63	28.28	6.00	44.15	50.15	52.4	7.3
577959	36–50	1.80	2.12	5.08	11.21	11.46	24.83	6.48	37.02	43.50	34.3	7.9
Solano fine sandy loam:												
577910	0–12	.22	.64	4.13	24.88	22.05	33.03	4.57	10.48	15.05	15.6	5.3
577911	12–26	.37	.92	2.17	18.08	19.30	23.55	6.40	29.20	35.60	47.0	7.5
577912	26–38	.24	.15	1.62	15.10	17.85	29.84	4.38	30.82	35.20	50.0	8.4
577913	38–72	.19	.29	.48	26.32	18.84	24.17	5.01	24.70	29.71	47.0	9.2
Clear Lake clay adobe:												
577978	0–15	.09	.14	.34	2.69	4.00	22.35	12.69	57.70	70.39	32.7	7.8
577979	15–30	.06	.10	.37	2.13	3.98	24.08	12.38	56.90	69.28	37.9	8.4
577980	30–54	.13	.26	.44	3.11	4.55	26.53	12.00	52.98	64.98	57.5	8.5
577981	54–72	.43	.31	.61	7.29	11.67	28.09	8.89	42.71	51.60	59.7	8.6
Sacramento clay:												
577920	0–12	.09	.41	.68	1.32	.75	12.54	19.12	65.09	84.21	55.1	8.0
577921	12–48	.02	.83	.35	1.25	.11	16.69	19.85	60.90	80.75	57.1	8.2
577922	48–72	.00	.01	.02	.06	.10	22.41	28.90	48.50	77.40	55.1	8.5
Columbia silty clay loam:												
577928	0–36	.12	.09	.26	.77	12.83	59.70	8.30	18.38	26.68	29.5	8.7
577929	36–72	.13	.47	.54	7.09	16.90	41.42	8.91	24.54	33.45	30.4	9.0

The moisture equivalents were determined by the standard method that has been in use in California for years. The soils were air-dried, screened through a 2-millimeter sieve, and the moisture equivalents determined by using a weighed amount (30 grams) in the cups of a centrifuge developing a force of 1,000 times gravity. The results are expressed in terms of percentage of moisture calculated on the basis of oven-dry weight. Experiments have proved that the moisture equivalent coincides approximately with the normal field-moisture capacity or the amount of water that is held in the soil after heavy rains or irrigation, where downward drainage is free and uninterrupted. The moisture equivalent reflects the influence of large quantities of colloidal clay and organic matter. No striking divergence from the normal relations between moisture equivalent and clay content is shown. The soils of the Sacramento series and the surface soil of Capay loam contain comparatively high proportions of organic matter.

The mechanical analyses of these samples were made by the modified pipette method. The soils were air-dried and screened through a 2-millimeter sieve. Subsamples were then taken, treated with hydrogen peroxide to destroy the readily oxidizable organic matter and with weak hydrochloric acid to remove the carbonates. The excess of acid was removed by thorough washing, and the soils oven-dried to determine loss due to pretreatment. They were then dispersed by shaking with sodium oxalate as a deflocculating agent. The thoroughly dispersed soil was then washed through a 300-mesh sieve which retained the sand particles. These sand particles were dried and screened to the standard grades. The silt and clay suspension was made up to the proper quantity to fill tall cylinders, stirred thoroughly to make sure that the particles were well dispersed, and then allowed to stand in a constant-temperature chamber during the period of settling. Samples were withdrawn by a single-orifice pipette at the end of definite periods, as calculated by Stokes' law, to recover all particles 5 microns and less and 2 microns and less in effective diameter. In table 4 clay particles range from 5 to 2 microns in diameter and ultra clay particles are less than 2 microns.

The severe pretreatment with hydrogen peroxide and hydrochloric acid disintegrates many fairly stable aggregates and gives a clay content that is usually considerably higher than that obtained by the centrifugal method of analysis, using ammonia as the deflocculent. All the surface soils were analyzed by the centrifugal method as well as by the pipette method, and in every sample the quantity of total clay was much greater when determined by the pipette method. In most samples this added clay came from the sand fractions, apparently being due to the washing of colloidal clay from the surface of the sand grains. The fine sandy loam surface soils of the Hartley and Yolo soils and the silty clay loam surface soils of the Columbia and Zamora soils showed a marked increase in the silt content as well as in the clay, with an equivalent decrease in the sands. With the clay loam types of the Los Osos and Capay series and the loam and clay types of the Capay series, the increase was wholly in the clay fraction, there being practically no change in the quantity of silt. The surface soils of Yolo silt loam and of the

fine sandy loam members of the Olcott, Solano, and Hartley series showed a material increase in the silt fraction with a much smaller increase in clay, usually the increase in silt, by reason of the more drastic pretreatment, being from 3 to 5 times greater than the increase in the clay content. The clay loams of the Hugo, Zamora, and Sacramento series, the silty clay loams of the Capay and Yolo series, Sacramento clay, and the clay adobes of the Clear Lake and Denverton series, all showed a decrease in both sand and silt, with a corresponding increase in clay. In all these soils, except the clay adobes, the silt lost from one-fourth to one-half as much as the sand. Sacramento clay, Clear Lake clay adobe, and Denverton clay adobe showed the silt losing from 2 to 3 times as much as the sand. It is very evident that with the heavier textured soils the more drastic pretreatment in the pipette method of mechanical analysis breaks up many fairly stable aggregates and so shows a larger proportion of clays. With the heaviest soils much of this comes from the fraction that in the mechanical analysis by the centrifugal method would be included as silt. The textural grades—sandy loam, loam, clay loam, etc.—were established on the basis of their mechanical analyses by the centrifugal method, and if the standards so established are compared with the results shown in table 4, it will be noted that most of the soils show much too great a content of clay for the textural name given them. This is owing to the increased dispersion brought about by the severe pretreatment. The textural names, as given in table 4, have been determined after careful study of the soil samples and comparison with the centrifugal analyses, wherever the latter were available, and are correct on the basis of their field characteristics. Further research is necessary to determine the relation between the textural name and the content of silt and clay as shown by the method of analysis which uses severe pretreatment.

The reaction of the soil was determined by use of the hydrogen electrode and is reported in the column headed pH. The primary soils (Los Osos and Hugo soils), formed from material produced by residual weathering of sandstone and shale rocks, show a distinctly acid reaction, either rather uniform throughout the solum or decreasing with depth. The recently developed soils range from neutral to moderately basic in reaction, with a pH value ranging from 7 to 8 and without any definite trend or change in any horizon of the profile. The older basin soils show a moderately basic reaction in the surface horizons, increasing to as much as pH 9 in the subsoils. On the valley slopes between the bases of the hills and the basins, the moderately developed well-drained soils have slightly acid surface horizons ranging from pH 6.5 to 7, and subsoils neutral or basic, ranging from 7 to somewhat above 8. The solonetzlike soils of the flatter valley slopes show distinctly acid surface horizons ranging from as low as 5.3 pH to as high as 6.6. The upper part of the columnar horizon is usually neutral, but the deeper part of the subsoils is distinctly basic, in some places being as high as 9.2. These studies show that the primary soils are acidic throughout the solum, the recent-alluvial soils neutral or moderately basic, the moderately developed soils slightly acidic in the surface horizons and basic in the subsoil horizons, and the solonetzlike soils

strongly acid in the surface horizons and strongly basic in the subsoil horizons.

The nitrogen and organic-matter contents of many of the samples were also determined. The nitrogen in the surface soils ranged from 0.06 to 0.32, and that of the subsoil horizons ranged from 0.02 to 0.1, with the exception of Sacramento clay, which contained 0.17 between depths of 12 and 48 inches, and 0.089 between depths of 48 and 72 inches, and Sacramento clay loam which contained 0.224 in the subsoil. Most of the surface soils have an organic-matter content ranging from 2 to 4 percent, with more than 6 percent in Capay loam, Sacramento clay, and Sacramento clay loam. Under the climatic conditions existing in this area, organic matter is rather rapidly destroyed by bacterial activity, and even large quantities added to the soil soon disappear. The soils of the Sacramento and other series that occupy the basins show the highest content of organic matter, in part owing to the submergence and partial preservation of the organic remains during times of submergence.

SUMMARY

The Dixon area is in the southwestern part of the Sacramento Valley of California, at the eastern base of the coast range. It has a total extent of 435 square miles. The boundaries of the area form a rough rectangle including the northern part of Solano County and the contiguous southern projection of Yolo County. Most of the inhabitants are engaged in agricultural pursuits. Vacaville and Dixon are the only incorporated towns. Transportation facilities are good.

The climate is characterized by hot dry summers and cool moist winters, although differences occur both in temperature and precipitation in different parts of the area. At Vacaville the frost-free season extends over a period of 8 months, the adjacent uplands are favored with warmer winters and a longer growing season, and the eastern lowlands have cooler winters and warmer summers.

The early subsistence type of farming soon gave way to cattle raising, and this industry was later outranked in importance by the production of wheat and barley. Orchards and vineyards next received attention, and fruit growing began to spread over the area. With two possible exceptions, the agriculture has been marked by no unusual developments since the late eighties. By reason of levee construction and reclamation, a distinctive and intensive agriculture was developed on the large areas of low wet lands along Sacramento River, and during and immediately following the World War, a temporarily increased planting of such crops as wheat took place.

Orchards of cherries, apricots, peaches, and plums now occupy most of the favorable sites in the northwestern part of the area. Sheep raising is the most important livestock industry, and dairying and mixed farming are engaged in on the more desirable and fertile land climatically unsuited for fruit culture.

The soils represent 13 series and include 21 soil types, 11 phases, and 3 classes of undifferentiated and miscellaneous materials. The distribution of each of these is more or less restricted to one or another of the seven physiographic subdivisions into which the area

is divided. From west to east, these are: The eastern slope of Vaca Mountains, the structural trough occupied by Vaca and Pleasants Valleys, the dissected uplands of English Hills, the older alluviated part of the main valley plain, the part of this plain subject to present alluviation, the Yolo By-Pass, and the reclaimed lands along Sacramento River.

The leading natural agencies, other than climate, affecting the distribution of crops, are surface features, water supply, and soils.

The more favorably located areas of the Los Osos and Hugo soils are used for fruit growing and the rest of the land for grazing. Probably the most desirable soils for the production of intensive crops are the Yolo. The Zamora soils are used both for intensive crops and for sugar beets.

The 13 series of soils are representative of four major groups of soils, grouped on the basis of their genetic characteristics and conditions and stage in profile development. The Los Osos, Hugo, and Denverton soils are primary soils developed on hard or softly consolidated rocks occurring in the western elevated part of the area. They are subject to erosion, and their profiles are shallow and comparatively immature.

The Yolo, Zamora, Esparto, and Capay soils are secondary soils occurring throughout the main valley plain and in the foothill valleys. They have developed under contemporary alluviation, and their profiles range from unmodified or immature to moderately mature, the character and degree of development and depth and thickness of profile horizons depending on the character of the parent materials, rate and recency of alluvial increment, drainage, and other local environmental factors.

The Hartley, Olcott, and Solano soils are solonetzlike soils developed in the western part of the main valley plain on old sedimentary materials. They are not now being subjected to appreciable erosion or alluviation and are probably the most mature soils of the area.

The Clear Lake, Sacramento, and Columbia soils are secondary soils developed in the depressions of the main valley plain and in the basin district, where they have been subject to a high water table, frequent overflow, ponded drainage, wet- or marsh-land vegetation, and have a comparatively high organic-matter content.

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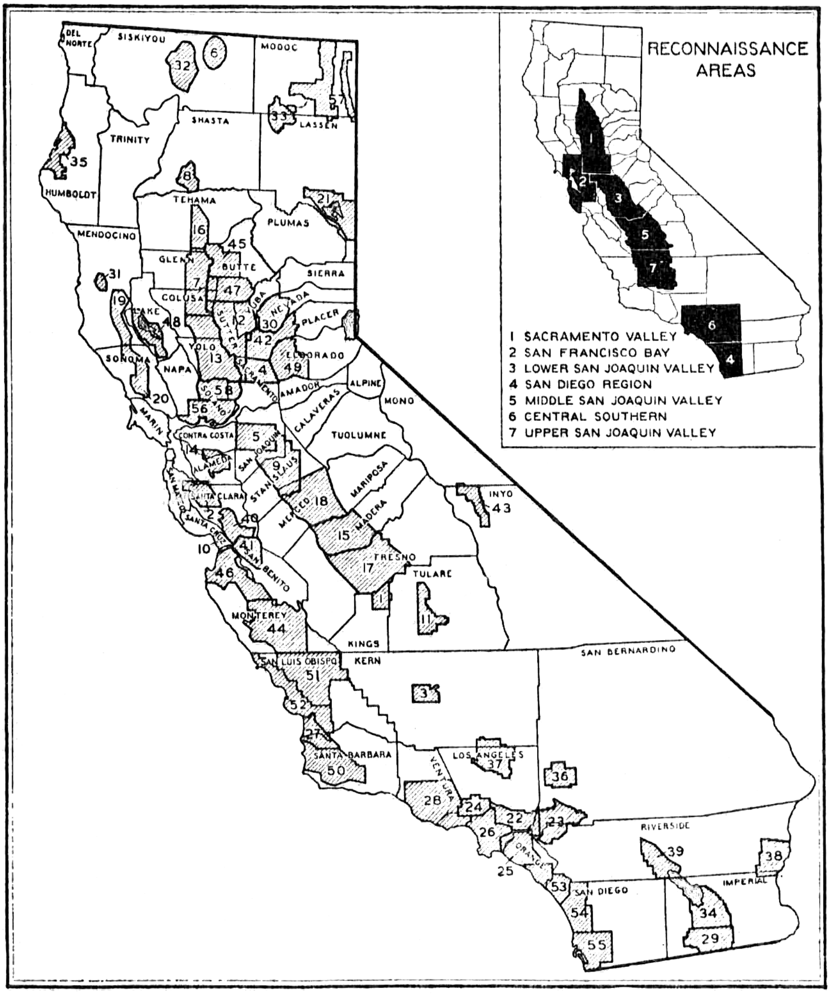

Areas surveyed in California, shown by shading.

1. **Hanford.**
2. **San Jose.**
3. **Bakersfield.**
4. **Sacramento.**
5. **Stockton.**
6. **Butte Valley.**
7. **Colusa.**
8. **Redding.**
9. **Modesto-Turlock.**
10. **Pajaro Valley.**
11. **Portersville.**
12. **Marysville.**
13. **Woodland.**
14. **Livermore.**
15. **Madera.**
16. **Red Bluff.**
17. **Fresno.**
18. **Merced.**
19. **Ukiah.**
20. **Healdsburg.**
21. **Honey Lake.**
22. **Pasadena.**
23. **Riverside.**
24. **San Fernando.**
25. **Anaheim.**
26. **Los Angeles.**
27. **Santa Maria.**
28. **Ventura.**
29. **El Centro.**
30. **Grass Valley.**
31. **Willits.**
32. **Shasta Valley.**
33. **Big Valley.**
34. **Brawley.**
35. **Eureka.**
36. **Victorville.**
37. **Lancaster.**
38. **Palo Verde.**
39. **Coachella Valley.**
40. **Gilroy.**
41. **Hollister.**
42. **Auburn.**
43. **Bishop.**
44. **King City.**
45. **Chico.**
46. **Salinas.**
47. **Oroville.**
48. **Clear Lake.**
49. **Placerville.**
50. **Santa Ynez.**
51. **Paso Robles.**
52. **San Luis Obispo.**
53. **Capistrano.**
54. **Oceanside.**
55. **El Cajon.**
56. **Suisun.**
57. **Alturas.**
58. **Dixon.**

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SOIL MAP
DIXON AREA
CALIFORNIA

UNIVERSITY OF CALIFORNIA
AGRICULTURAL EXPERIMENT STATION
C. B. HUTCHISON, DIRECTOR
CHARLES F. SHAW, IN CHARGE SOIL SURVEY

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort
Secondary roads and Trails
Railroads Steam and Electric
Bridges, Ferry
R.R. crossings, Tunnel
Ford, Dam
School or Church Cemeteries
Mine or Quarry Mine dumps Made land
Bluff, Escarpment, Rock outcrop and Triangulation station
Stony and Gravelly areas
Soil boundaries
Boundary lines (State, County)
Boundary lines (Land grant, City or village)
Boundary lines (Civil township, Reservation)
U.S. township and section lines

RELIEF
(Printed in brown or black)

Contours Depression contours
Prominent Hills Mountain Peaks
Sand, Wash, and Sand dunes
Shore and Low-water line, Sandbar

DRAINAGE
(Printed in blue)

Streams
Lakes, Ponds, Intermittent lake
Intermittent streams
Springs, Canals and Ditches, Flumes
Swamp Salt marshes
Submerged marsh Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

LEGEND

Capay loam — Cl
Los Osos clay loam — Lc
Capay clay loam — C
Lc — Steep phase
Capay silty clay loam — Cs
Olcott fine sandy loam — Of
Capay clay — Cp
Of — Red phase
Cp — Red phase
Sacramento clay loam — Sl
Clear Lake clay adobe — Ca
Sl — Friable-subsoil phase
Columbia silty clay loam — Cy
Sacramento clay — Sy
Denverton clay adobe — Da
Solano fine sandy loam — Sf
Denverton and Hartley soils (*Undifferentiated*) — DH
Sf — Brown phase
Esparto silty clay loam — Es
Yolo fine sandy loam — Yf
Es — Light-textured phase
Yf — Shallow phase
Hartley fine sandy loam — Ha
Yolo silt loam — Yl
Ha — Brown phase
Yolo silty clay loam — Ys
Hugo fine sandy loam — Hf
Ys — Calcareous-subsoil phase
Hugo clay loam — Hc
Zamora clay loam — Zc
Hc — Steep phase
Zc — Heavy-textured phase
Los Osos and Hugo soils, (*Undifferentiated*) Steep phase — LH
Zamora silty clay loam — Zl
River wash — Rv

Macy H. Lapham, Inspector, District 5.
Soils surveyed by Stanley W. Cosby, University of California, in charge, and E. J. Carpenter, U. S. Department of Agriculture.

BASE MAP IN PART FROM
U. S. GEOLOGICAL SURVEY SHEETS

Scale $\frac{1}{62500}$
1 ½ 0 1 2 3 4 Miles
1 ½ 0 1 2 3 4 5 Kilometers
Contour interval 10 feet.
Datum is mean sea level.

Field Operations
Bureau of Chemistry and Soils
1931